North American Forests and Forestry

Their Relations to the National Life of the American People

BY

Ernest Bruncken

Secretary of the late Wisconsin State Forestry Commission

G. P. Putnam's Sons
New York and London
The Knickerbocker Press
1900

The Knickerbocker Press, New York

CONTENTS

CHAPTER IV

CHAPTER V

CHAPTER VI

CHAPTER VII

NORTH AMERICAN FORESTS AND FORESTRY

NORTH AMERICAN FORESTS AND FORESTRY

CHAPTER I

INTRODUCTION

MODERN civilization attains its height, and produces its blossoms and fruits, such as they are, for good and evil, in the artificial life of the great cities; but its roots are sunk deeply into the soil prepared by nature herself. Millions of years before the first spark of intellectual life in a humanlike being made the beginning of a rude culture possible, that mysterious earth-life which throbs in the multitudinous surges of the ocean, the stormy atmosphere enveloping the crags of the Sierra, the torrid sunshine of the desert, the splashy brook of the meadow, and the soughing pines of the forest, had laid deeply and lovingly the foundations without which there could have been none of the rich, full, invigorating activity of city life. Cut the threads which connect the humanity of New York and Chicago with the remotest solitude, and civilized life must wither and die.

To him who tries to understand with head and heart the subtle cords joining his own individuality to the natural conditions about him, as well as to him who takes his place as one of the fighters in the struggle that lifts mankind to ever greater heights, to the thinker as well as the doer, the connection between civilization and nature cannot fail to be of never-ceasing interest. To show in a comprehensive glance how this connection is formed in the case of one of the most important of the great forms of earth-life, the forest, is the object of this little volume.

It is a subject worthy the attention of the philosopher, the statesman, the economist, the man of science, the business man, the lover of mankind and of nature. But let no one imagine that it is a subject for the idler, the dreamer, the selfish dilettante who is a mere looker-on in life's battle. To that false theory of life which cannot find in the common activities of man anything but sordidness, which cannot discern the dignity at the core of the laborer's task with axe and saw, or concealed under the dust and chaff of the market-place, forests and forestry are incomprehensible. Nor is it a subject for sentimentalists to play with, and tickle their pretty fancies and emotions. Forestry is a subject for men who stand in the midst of the world's struggle doing their part with brain and brawn, and feeling the joy which is the heritage of the strong in victory or defeat.

With the heart-life of the wilderness the forester

has a sympathy so deep and true that the poetaster who sings his dainty elegy on the death of a tree cannot even imagine it. This very depth and truth help him to realize that the primeval wilderness is but one of the changing forms of life, which plays its part and does its task, and presently must give way to other and better developments. Nature untouched by human hands is beautiful and grand, but grander and more beautiful is the life of man, with its constant striving for a more complete subjection of the forces and matter of nature to the aspirations of the human spirit. Nothing could be farther from the intention of the author, as it is from the mind of the forester who loves his work, than to swell the chorus of those who ignorantly, although often in imagined superiority of knowledge, cry out against the activity of those sturdy and simple men who are adding untold millions to the national wealth by utilizing the stores which nature has prepared for us by the patient work of untold ages.

But the author, like the true forester, would fain do his share to combat, wherever he finds them, the ignorance which wastes instead of using the riches kind nature has prepared for us; the heedlessness that does not take the trouble to do its best; the greed that overreaches itself in its haste to get all; the selfishness which cares not for its neighbor, though he suffer and perish. The professional forester will not find in this book anything that is not already familiar to him, and will

miss much that he may deem important. But to him these pages are not addressed. They desire to be read by the many who take a living interest in all questions affecting the welfare of the nation, and by those who love the life of nature without standing apart from the more strenuous current of human existence. To such the book may be a convenient help to obtain a comprehensive knowledge of a subject that has already engaged the attention of many of the leading minds of the country, and must soon come to the front as one of the great questions demanding solution by the American people and putting to a severe test the efficiency and permanence of its democratic form of government and society.

CHAPTER II

THE NORTH AMERICAN FOREST

THERE are in the northern temperate zone three great forest regions: The eastern Asian, including principally the eastern portion of Siberia, Manchuria, and the Japanese archipelago; the European; and the American forests, including great portions of the United States and Canada. The American forest may be subdivided into three groups: The great eastern forest, which originally covered nearly all the territory on the Atlantic side of the Mississippi, and in several places extends considerably beyond that river; the forests of the Rocky Mountain regions, including the minor mountain ranges of the great basin; and the Pacific coast forest. The immense areas lying between these subdivisions are occupied by the grass plains of the eastern slope and the alkali and sage-brush deserts of the interior, both of them distinguished by the almost total absence of tree growth. On the northern edge these three forest zones converge, so that there is a subarctic forest belt stretching from ocean to ocean. We have before us the task of describing the relations existing between the life of the American people as a social organism, and

the forest with its manifold productions. It seems natural to begin by considering the characteristics of the forests themselves, such as they were before the hand of man wrought the vastly changed conditions under which they now exist In doing so we cannot think of delineating in detail the botanical or physiographic phenomena of this great form of plant life. He who would learn of the different species of trees composing it, their dendrological character, their manner of life and growth, will have to look elsewhere for such information. Nor will we have space to wax eloquent about the beauty of our sylvan inheritance. Although the esthetic point of view has its very important place in our relations to surrounding nature, we cannot in this volume concern ourselves with that aspect. What this initial chapter seeks to impress firmly upon the minds of such as may feel inclined to follow the author through these pages is simply this: the manner in which the various trees are associated in the wilderness is not the result of accident, but determined by complex, but very definite, laws. If one had a perfect knowledge of those laws he could predict with absolute certainty the number, species, and character of the trees to be found in any given locality. And further: the forest is not a thing that was made once and remained the same ever after. It has grown and develops as a whole, just as each individual tree grows from infancy to old age. Again, this growth and constant change takes place according to very

complex and unalterable laws. Each tree does not constitute an independent entity, but is affected in every moment of its life by every other tree and minor plant of the entire forest, and in turn itself influences every other tree. The forest therefore constitutes an organism, having a united life different from, but dependent on, the life of its individual members. Within this organism, a never-ceasing struggle is going on, tree fighting against tree, species against species; while the entire organism carries on a warfare with other plant associations, such as the prairie and the bog, in which it is sometimes vanquished, sometimes victorious.

To the ingenuity of man, with the help of such knowledge as he may acquire of the laws regulating the life of the forest organism, it is possible to make use of the various phases of this warfare for his own purposes. By creating conditions favoring some particular species of tree he is able to help it to spread and flourish at the expense of its competitors; and similarly he may create conditions which help the forest as a whole to maintain itself against the aggression of other plant associations. No small part of silviculture—or the art of caring for woodlands—consists in just such interference in the natural processes of forest development, rather than planting and sowing. In order to understand the relations of forestry to our national life, the reader should have in his mind an outline at least of what American forests are like, and also of how they came to be what they are.

Each of the three main subdivisions of the North American forest has peculiarities distinguishing them from the others. Let us first look at the great Atlantic region. This immense territory was, when white men first came to our shores, almost uninterruptedly covered with forest. For thousands of square miles, in many portions of it, there was not enough open space to establish a forty-acre farm on. There was an occasional strip of sedge-covered marsh along the streams; an open bog had here and there taken the place of a former lake. The few small clearings made by the Indians were hardly worth counting. Thus the interminable woods extended from the salt meadows of the tide-water line to the Appalachian Mountain chain, swept up its ridges and peaks, leaving bare but a few of the highest tops, filled the broad longitudinal valleys, and descended into the great rolling plain of the Mississippi country. But here its character changed by degrees. More and more frequently the vast continuity of it was interrupted by prairies, grass-covered and flower-studded, many of them of vast extent. Towards the north, to be sure, in what are now the northern portions of Michigan and Wisconsin, Northeastern Minnesota, and especially the immense territory between the Great Lakes and Hudson Bay, there are no prairies. The dense unbroken forest, the "heavy timber" as it is called by the people of the locality, is there bounded quite abruptly by the treeless expanses of the Great Plains, where the

miserable inhabitants talk of a forest when they see a few willow shrubs and poplars in a ravine by the river. But farther to the south, there was a large region where forest and prairie struggled for mastery, with the result that, generally speaking, the prairies covered the undulating uplands, sedge marshes the wet, broad depressions, and forests the river valleys, as well as the few hilly places. There were also light groves, called openings, in many places in the uplands.

The species constituting this great area of primeval forest were far from being the same in all parts of the territory. Far to the north, on the bleak shores of Hudson Bay, hardly anything was found except spruce (*Picea mariana* and *P. canadensis*), together with the balsam poplar (*Populus balsamifera*). As you go south, the first additional trees you meet with will be the little jack pine (*Pinus divaricata*) and the aspen (*Populus tremuloides*). Soon you enter the domain of the king of lumber trees, the stately white pine (*Pinus strobus*), with her cousin, the misnamed Norway (*P. resinosa*), and the dignified, slow-growing hemlock (*Tsuga canadensis*). By this time you are fairly within the realm of the broad-leaved trees, the oaks, maples, beeches, chestnuts, the walnuts and hickories, the tulip tree and sassafras, the gigantic sycamore, or buttonwood as they call it in the Eastern States. The farther south you go, the greater becomes the number of species, until when you reach about the latitude of Kentucky or Southern

Illinois the list becomes so long that it would fill several pages of this volume. Here and in the region of North Carolina the eastern forest reaches its greatest development so far as diversity of trees is concerned. Farther south, the coniferous trees, especially the different kinds of pine, again become more prominent, as they were towards the border of British America. The southernmost end of the region, the extreme southern part of Florida, with the adjoining islands or "keys," takes on a different character, many varieties properly belonging with the typical West Indian species. The most distinguishing feature of the whole region, excepting the arctic edge, is the prevalence of broad-leaved trees. Over very wide areas not a coniferous tree can be seen, unless it be the arbor-vitæ (*Thuja occidentalis*) and tamarack (*Larix laricina*) of the swamps. Elsewhere broad-leaved and coniferous trees grow mingled together, with broad-leaved ones holding the decided majority; while, to be sure, there are also large areas where the pines and their congeners exclude their broad-leaved rivals almost altogether.

But in the other two forest zones, the Rocky Mountain and the Pacific, the coniferous or evergreen trees have almost a monopoly. Not as if there were no broad-leaved species in those sections. There are many, oaks, maples, poplars, and others. But they form little scattered groves here and there, or crouch in the ravines of the mountain streams, without impressing themselves upon the

character of the landscape. There is another feature of the western forests, or the larger portion of them, which makes their aspect quite different from eastern woodlands. That is the fact that the trees, in many cases, stand far apart, so that their crowns do not always touch. While in the east the trees, both broad-leaved and evergreen, stand so close together that the branches intermingle and form a dense canopy, through which but few scattered rays of sunshine ever reach the ground, such is not the case in the forests of the Rocky Mountains or the Sierra Nevada. One of the consequences of this manner of growth is that the soil in the western forests becomes much drier than it ever does in the east. This fact will probably have an important bearing upon silviculture when that is begun in earnest in the western country. Another feature distinguishing the forests of the Rocky Mountain region from those of the Atlantic side is that they nowhere cover such immense areas in unbroken compactness. They are distributed along the mountain ranges in belts, leaving bare the highest portions where reigns the eternal snow, and rarely occupying the broader valleys and plains.

Not only have the pines and other coniferous trees the overwhelming majority of numbers in those western forests; they also display a far greater variety of species, compared with eastern woods. Some of the western species, like the western white pine (*Pinus flexilis*) or the bull pine (*P. ponderosa*), spread over large areas, while others,

like the Monterey pine (*Pinus radiata*) or the redwood (*Sequoia sempervirens*), are restricted to a few valleys or mountain ranges. Of the 109 coniferous trees native to the United States and enumerated in Sudworth's list, eighty belong to the country west of the great plains, twenty-eight to the eastern forest, while only one, the common juniper (*Juniperus communis*), inhabits portions of both regions.

What has been said about the peculiarly open character of much of the western forest does not apply to those portions found in the western halves of Oregon and Washington, and thence stretching along the coast into Alaska and far towards the Arctic regions. On the contrary, these are among the densest woods in the whole world, where under the vaults of the immense crowns, that are swung from the column-like trees at a height of 100 or 150 feet, eternal twilight covers the ground. Of all the forests of the world these have the most gigantic trees, barring only the Sequoias of California, of which we will speak anon. Compared to the spruces, firs, and pines of the Puget Sound region, the mightiest of eastern pines and even the giant sycamores of Illinois and Indiana river bottoms are but smallish. No one who has entered those dense forests composed of trees 250 feet tall and having six and more feet in diameter has failed to be impressed with their grandeur, and literature is filled with attempts to describe their majesty. But they are surpassed by the

redwood (*Sequoia sempervirens*), that magnificent, cypress-like giant which forms a belt, from ten to twenty miles wide, along the California coast from the Oregon boundary to a point in Monterey County, a little north of San Francisco. And even the redwood is not equal in size to the famous big tree (*Sequoia gigantea*), the pride of the Sierra. This tree is known to tourists principally by the comparatively few specimens growing in the protected groves of Calaveras and elsewhere. But it reaches its grandest development farther south, in the southern part of the Sierra, where it forms, not small groves, but extensive forests.

How did the forests and the species composing them come to be distributed over the North American continent in just the peculiar manner in which we find them? Before very much was known about plant geography, people used to be content with saying that each tree found itself in that region the natural conditions of which were most adapted to its nature. But such vague answers no longer content us to-day. The science of palæobotany, or the knowledge of the plants which existed on the globe in former geological periods, has helped us on the track of this secret of nature. To be sure even now we know these things fragmentarily only, and an almost limitless field is here still open to investigation. But this we can now affirm: The distribution of trees is due to two sets of factors,—one topographical and climatic, based upon the differences of soil, elevation,

temperature, humidity, and so forth. The other factor is historical, arising out of the order in which the seeds of different species were deposited in each particular locality, or failed to be so deposited.

The palæobotanists, drawing their conclusions from the remnants of wood, impressions of leaves, flowers, and fruit, and other small relics of extinct vegetation which are found imbedded in rocks and beds of coal or peat, have established the fact that during what are known as tertiary times, vast forests, composed of trees not very different from those now growing in the United States, existed in far northern regions, nearly up to the pole, where now everything is decked with ice and snow. But the warm climate of the tertiary ages was succeeded by the secular winter, which is known as the glacial period of the quaternary epoch, and of which most of my readers have heard. Farther and farther south crept the great glaciers, joined by those flowing down from the high mountains of the west, until the whole northern part of the continent, as far south as the latitude of Cincinnati, and even beyond, was covered with a sheet of ice of immense thickness, leaving but here and there an island uncovered, like the celebrated driftless area of Southwestern Wisconsin. Before the advance of the ice and the cooling of the climate that was both cause and consequence of the glaciation, the forests succumbed, and the species composing them were either extinguished or became restricted to more southern latitudes. But after thousands of years the climate

gradually became milder, the edge of the continental ice sheet slowly melted, forming immense rivers and lakes. As the land was laid bare, vegetation recovered the lost territory step by step. At first, the character of the land recently left by the ice was undoubtedly very much like what we find to-day in the Barren Grounds, the solitary regions in the northern part of the British dominions. There we find vast areas covered principally with mosses belonging to the genus *Sphagnum*, interspersed with a few sedges and numerous species of the heath family. It is a vegetation very similar to that of the peat bogs found occasionally in the Northern States. These moss prairies or tundras were gradually supplanted by the advance-guard of the forest: spruces and poplars, that came slowly marching up from the south and are, in all probability, continuing their advance to this day. These most arctic of American trees were followed by the pines, and these again by the more southern species of hardwood, maples, oak, beeches, and the like. While thus the forest as a whole was advancing northward, the various species fought among themselves for each locality. This fight continues to the present day, and is changing the distribution of species from century to century. It is very probable, for instance, that both north and south the hardwoods are gaining ground at the expense of the pines and spruces. The hemlock does not reproduce itself in a portion of Wisconsin, and therefore will die out there

when the present generation of trees has run its course, unless man interferes. The red and black oaks are gradually supplanting the white oaks in many parts of the country.

We have repeatedly used the terms warfare and fighting for the competition of trees among themselves, and it is time to give the reader an idea of how such warfare is going on. Trees have no claws and teeth with which they can attack each other as animals do, but they can fight, nevertheless, and the numbers of the dead and crippled in these battles are tremendous.

There are two things which every tree needs, or it must die: moisture for its roots, to carry water containing in solution various mineral salts to all parts of its body, and light to enable the leaves to assimilate the material so furnished, and build up the various vegetable tissues making up the tree. Each kind of tree, by reason of its specific characteristics, requires these two things in varying proportions. For each species there is a minimum of light, and the accompanying warmth, and also a maximum; exceeding these limits, suffering begins. The same holds true of moisture, as well as some other requisites. For instance, most trees will die if their roots are immersed in water for a large part of the growing season. But a few, like the black ash or bald cypress, will grow lustily on swamps wet the year through. They have a very high moisture maximum. On the other hand, these species would not flourish on a dry, rocky

ridge. The conditions there would be below their moisture minimum; while a black spruce, for instance, will grow in a Northern Wisconsin swamp no less than on a dry rock in the Adirondacks, because it is adapted to a very large range of moisture conditions.

As to light, dendrologists have divided trees into two classes, light-loving and shade-enduring species. The two classes, however, connect by imperceptible transitions. Generally speaking, the needs of a tree as regards light can be told by the character of the shade its own crown makes. The oaks, for instance, need much light, and an oak sapling that stands in a dark, shady place will never grow to be a good-sized, healthy tree. Now, everybody must be struck with the light character of an oak grove, where the sun rays everywhere penetrate to the ground and paint fantastic figures on the vigorous growth of grass and herbage. A maple grove is much darker, and if you enter a wood composed of beeches or hemlock, you find yourself in almost nocturnal twilight, where no ray of the sun succeeds in reaching the ground. The need of light for the light-loving trees is particularly great in their youth; while on the other hand, the seedlings of the shade-enduring trees often die when they are exposed to too bright sunshine. If the seed of a light-loving tree should fall under the crowns of a group of beeches, it would have very little prospect of growth, while the young beeches would grow lustily. Here is one of the ways in which species of trees carry on

their warfare. Suppose that on a tract of land covered with oak, birches, or other light-lovers, the seed of beech, maple, or other shade-endurers should be deposited. The light coming through the crowns of the established species would be sufficient to start the young invaders into vigorous growth; the seedlings would gradually develop into trees, each forming its usual dense crown and casting a deep shade on the ground under it. By and by they will distribute their seeds, some of which will grow into trees, and it will make no difference to them whether they are rooted under their parent species or under the neighboring oaks. In either case, the light conditions are favorable. But with the seeds cast by the oaks things are different. If they sprout under one of their parent species they will grow. But those that come to lie under the beeches do not find light enough, and either do not sprout at all, or soon languish and die. By and by some of the old oaks will perish, from accident or age. In the new growth the beeches already have the majority, and the percentage in their favor is constantly increasing. After some centuries the oaks will have disappeared, and in place of the sunlit oak grove there now stands a cool, shady beech wood. The war has resulted in victory for the invader. Of course, the light conditions are not the only factors to decide the struggle, else the light-loving trees would long ago have become extinct. It might happen, for instance, that when the seeds of the shade-enduring

species reached the place, they found the light conditions favorable all over the locality, but in one half of it the soil or the moisture relations were such that the newcomers could not endure it. Then the result of the war would be, that on one half of the tract the beeches have superseded the oaks, while on the other the oaks remain in undiminished vigor. The conditions affecting the outcome are rarely so simple as we have here assumed for the sake of clearness. Ordinarily, they are exceedingly complex, so that it becomes very difficult to trace them. But a knowledge of these processes is necessary for the skilful pursuit of silviculture. One important practical rule we may mention here, which is based on this observation that the species of tree growing in any given place is not always directly regulated by the natural circumstances of the locality, but influenced by the competition of other species. It is this: The fact that in any region a species is never found except in places of some special character, as in swamps, or on sandy soil, does not prove that it will not flourish elsewhere. It may have been driven into these retreats by its competitors, and would really much prefer the better places from which it has been excluded by them. This may often be of importance in silviculture, when it is desired to grow a tree outside of its apparent favorite habitat.

Just as each species competes with every other species for the most favorable places, so every individual tree competes with every other, whether

of its own kind or a different species. Again, the main objects of the struggle are light and moisture. To gain these necessaries, each tree adapts its manner of growth, the shape of its trunk, branches, roots, and leaves in a most marvellous manner. Everybody must have noticed that no tree is the exact counterpart of another of the same species. Aside from differences in age and size, each tree has a different way of disposing its branches, twigs, and leaves. This difference is invariably exactly of the kind which is most favorable to the growth of the tree under the particular local circumstances among which it must develop. As a tree cannot run away, it has to make the best it can out of the situation in which it finds itself as a seedling. Sometimes the devices the tree hits upon in difficulties are absolutely startling. Here is an illustration: At Devil's Lake, Wisconsin, a pine tree is standing on the side of the almost vertical quartzite rocks of the locality. It had originally sprouted in a cleft where there is hardly a shovelful of soil. The tree is now about six inches in diameter. From its little cleft, it sends out a single root, as thick as the trunk, along a narrow ledge, on which there is practically no soil at all. On the surface of this ledge, lying on the exceedingly hard rock, this root runs along, almost horizontally, for twenty-six feet, where it finds an accumulation of soil and enters the ground.

While there are infinite variations of form growing out of this struggle for moisture and light,

there are a few general rules of practical importance to the forester. A tree standing in the open, where the light strikes its crown from all sides, forms a round, symmetrical top, with the lowest branches not very far above the ground. Or if it is of the kind that has a pyramidal growth, like the spruces and most other coniferous trees, it may be clothed with living branches to the very earth. If the same kind of tree should grow in a place where it gets full sunlight from some directions, while other sides are shaded, the branches will all, or nearly all, grow towards the light, thus forming asymmetrical crowns. Now suppose that a tree of the same species should find itself standing in a dense clump of trees, where the light cannot reach it from any side. Then its only salvation is to reach the light which comes from above. Consequently it sends out few and small lateral branches, but puts all its energy into height growth, until it has grown above the shade cast by the surrounding trees. This done, it begins to spread its leafy branches in all directions, to absorb as much of the loved sunlight as possible. Where a number of trees grow closely together, so as to mutually hinder the light from reaching their leaves, a race for the sun ensues between them, in which those are victorious which by reason of their more energetic height growth first show their tops above the others. Then these begin to spread their side limbs, thereby throwing their rivals into ever denser shade, and the latter cease to grow

vigorously, and in course of time may even die. If they are of the shade-enduring kind, they have, of course, a better chance to survive than if they were light-lovers. In such a case they may even succeed, after a while, in their turn, in overtopping the first victor, because that ceased to grow much in height when the spreading of the branches began. But generally the tree which has once been overtopped by its neighbor never grows into a very large and vigorous specimen, but joins the ranks of the suppressed, which the skilful forester cuts out sooner or later to make room for their betters.

Not only do whole trees languish and die when they are overshadowed by others, but every branch shares the same fate if at any period of its life it is deprived of the free access of light, either by other branches of its own tree, or by neighboring trees. Where the trees stand close together, this happens to all the lower branches, which usually die and fall off during the first few years of their lives, so that not only are few side branches produced, but what few there are soon disappear again. Trees so grown consequently show tall trunks with only a few branches towards the top.

Now it happens that the quality of lumber cut from trees with tall stems is very much better than that produced by trees where the branches are many and reach far down the trunk, for every branch means a knot in the lumber. Consequently the forester who desires good lumber aims to make his trees tall and with as few

branches as possible on the lower part of their trunks.

When the tree has succeeded in growing above the heads of competitors and begins to spread its crown, it changes its economy in various ways. For one thing, as it is now enabled to provide itself with more leaves, it has a chance to produce greater amounts of wood: for each leaf is a laboratory where the material is distilled out of which wood and other vegetable tissue are formed. This increased formation of wood results in an increase of the diameter of the trunk, while the height growth is no longer as rapid as before. At the same time, the character of the wood changes, especially in those trees which have two kinds of wood, an inner core of heart-wood, and a surrounding layer of sap-wood. This is the case with most of our lumber-producing trees. The greater the diameter of such a tree trunk, the smaller the proportion of sap-wood, while a tall tree of very small diameter is nearly all sap-wood. As heart-wood is much more valuable for timber purposes, it follows that to make his trees most valuable the forester allows them to follow up the period of rapid height growth by a period of prevalent diameter increase. In other words, he now cuts away the weaker, half-suppressed trees, so that the remaining ones get the benefit of an open stand. Where this happens naturally in the wilderness, by one cause or the other, the result is, of course, the same as where the new condition is produced artificially. The forester's art in silviculture

never amounts to anything more than giving special direction to the processes initiated by nature.

One of the principal weapons which trees have in the propagation of their species is the production of immense quantities of seed, which are spread broadcast, trusting to accident that some will find a favorable spot to sprout and grow into a new tree. Evidently, the more seeds are sown, the greater is the probability that some of them will find such a spot. Therefore trees that are very fertile have an advantage over trees which produce a less quantity. But no matter whether few or many seeds are produced, a very small percentage ever succeed in becoming trees. In fact, it happens not rarely that of all the seeds scattered over the ground in any given year not a single one ever reaches the state of a seedling tree. Those who have never observed these relations are apt to assume that in a given tract of woodland, growing healthily under undisturbed natural conditions, one will be able to find trees of all ages, from the patriarch of several centuries down to the little seedling just showing the tip of its stem above the litter on the forest floor. But such conditions are rather rare, and the reason for that is not very hard to find. In the first place, the trees do not bear seed every year. Varying according to species and perhaps to habitat and other conditions, what is known as a seed year occurs but once in three, four, or five years, as the case may be. In such a year, every tree of the species, old enough to bear fruit at all, is full of

them, while in other years only here and there a few are ripening. Consequently it is only in seed years that there is much hope for any seeds to find a favorable sprouting place. But even then it may happen that not one of them has such luck. The condition of the ground has much to do with this. It may be that by one cause or other, as, for instance, too much moisture or too great dryness, it has become unfavorable to the seedlings, either by reason of its chemical or mechanical condition. The older trees are little affected by the change, for they send their roots deeply into the subsoil and the character of the surface layer is of relatively little importance to them. But the seedling depends for its life upon the condition it finds in this top-soil. More often the ground is shaded too much either by the crowns of the old trees themselves or by the undergrowth, which in turn may consist of former generations of young trees of the same species or of shrubs belonging to entirely different kinds of plants. In still other cases the ground may have been invaded by grasses or herbs, forming a matted tangle of roots and stems which make it difficult for the tree seeds to sprout. Under any of these and similar conditions long periods may elapse during which no reproduction of trees takes place, and the supply of many seed years may go to waste. But sooner or later an opportunity will come ; and the trees are always on the lookout to take advantage of accidents. One of the commonest of such accidents is the death and fall of one of the giants of

the forest. The prostrate trunk for a number of years encumbers the ground, but it has torn a wide breach into the leafy canopy on top, through which the bright sunlight enters the shady depth of the wood. Gradually the fallen tree decays, helped in this process by manifold fungi and other cryptogamic plants. After a while all that remains of what was once a tree is a heap of rich brown vegetable mould. As yet this is no place for a tree. Only mosses, ferns, and a few flowering plants which like to feed on organic matter and are known to science as saprophytes, or decay plants, find a congenial home here. But gradually, by various processes, among which the burrowing of animals plays no small part, the vegetable mould is mixed with the underlying earth, and true soil formed. Now is the time for the tree seeds, but if they do not hasten to occupy the spot, a host of other plants, herbs, grasses, and shrubs are lying in wait to get themselves established and preëmpt the ground. Of course, during the whole time while only fungi, mosses, ferns, and other specially adapted plants could live in the decaying mass, seeds of other species continued to arrive on the spot, but found it impossible to germinate. But now this has become possible for them, and intense rivalry between them follows. In this, if luck is with it, a young tree may come off victorious and in course of time develop into another giant like the fallen one on whose grave it grows.

This is but one instance where an accident

afforded opportunity for reproduction of trees in a wood otherwise unfavorable to young growth. Of course the variety of circumstances making such opportunities is infinite. Often it happens in the primeval wilderness that whole bodies of trees are overthrown by violent winds, and then the conditions brought about by the fall of a single tree are repeated on a larger scale. This matter of windfalls is perhaps not quite understood by the average layman. Generally speaking, trees adapt their manner of growth so as to withstand the violence of all winds to which they are likely to be exposed. The means by which they increase their power of resistance to storms are various. One of these is the elasticity of their fibres, even of the trunk, by virtue of which they bend before the wind, but immediately resume the upright position when the blast ceases. Another means of protection is a root system going very deeply into the ground, combined with great strength of the trunk. Unless the latter quality were added, a strong wind might not be able to uproot the tree as it would a shallow-rooted one, but the very strength and unyielding quality of the root would increase the danger of the trunk being broken off. Still another useful device is the very common thickening of the lower part of the bole just at the place where the greatest strain is suffered when the tree is bent. Now, within the limits set by the characteristics of each species, each individual tree develops these means of defence to a greater or less degree accord-

ing to the measure of its exposure ; that is, a tree growing in a place where strong winds are constantly blowing, as on the crest of a high mountain, develops as deep and stout a root, and strengthens its other wind defences just as much as its specific nature will permit. On the other hand, a tree growing in a protected ravine does not waste energy on such useless objects, but puts it into other forms of life activity. The trees in the midst of a compact forest protect each other, and consequently develop relatively shallow root systems. Only those at the edge of the wood, where the wind can reach them better, send their roots down deeply. Now suppose that, either by the hand of man or natural causes, an opening is made in the forest, so that individuals which heretofore stood surrounded by trees are now exposed to the wind on one or more sides. The trees now forming the edge of the wood will at once proceed to strengthen their root systems and thicken their boles, until they are as well prepared to resist the violence of the wind as if they had grown in an exposed situation from the beginning. But this process takes a number of years, and in the meantime they are in constant danger of being uprooted or broken off. Undoubtedly the majority of disastrous windfalls are in situations like the one described, where the trees had not yet become adapted to new conditions. But it may happen, of course, that a storm of unusual violence overthrows trees which had bravely withstood all ordinary tempests. The trees some-

times left standing by settlers on their clearings nearly always succumb to the wind sooner or later. Some species, which have shallow roots under the best conditions, are more liable to windfalls than others. Such are, for instance, the basswood (*Tilia Americana*) and the hemlock (*Tsuga canadensis*). Others, like the various walnuts and hickories, develop deep and stout tap roots even in the most sheltered situations, and consequently suffer little from this particular danger. Windfalls are a great detriment to the American forests. In addition to the direct damage, the tangle of drying branches and twigs affords one of the best starting-points for the fires of which we will have much more to say later on. The overturned trees are at once attacked by a host of insects and fungi which sometimes spread upon the adjacent sound timber and injure it.

To return to the opportunities which tree seeds find for sprouting, such as are small and perhaps provided with wings, or other devices enabling them to float for a while in the wind, have evidently a better chance than heavy seeds which cannot fall far from the parent stem. To the former class belong, among others, the seeds of poplars and birches, while conspicuous in the latter are the oaks and hickories. It is impossible to describe here even a few of the wonderful devices by which many seeds acquire this useful power to travel. How much advantage a tree derives from such power of its seeds can be seen conspicuously in the

case of the large areas in the Great Lake region which have been deprived of their former pine growth by the lumberman's axe and the fire. On these "slashings" the first trees which appear to provide a new forest growth are almost invariably poplars, especially the kind known as trembling aspen, and the white birches. These have especially effective apparatuses which enable their seeds to travel long distances. The pines, of which there are usually quite a number left on these "slashings," being trees that were too small for the lumberman, or of defective timber, have seeds which can be carried by the wind but a few rods at best. Consequently they cannot at once cover the whole area, the way the aspens do. But this instance also points the moral that the race is not always to the swift. Though the pines do not travel far, their little seedlings come up in numbers within a few rods about each seed tree. The growth of aspen, as well as bracken, grass, brambles, and other vegetation invading these areas, unless it gets to be too dense a tangle, is of advantage rather than otherwise to them, for it keeps off some of the scorching sunshine against which pine seedlings are rather sensitive. The aspen grows rapidly into saplings six and more feet high. The pines, for the first few years, grow but a few inches. Then they begin to shoot upwards, and by the time they are about fifteen years old, their tops begin to show above those of the aspen, that are now ten to fifteen feet high. Five years more, and the pines are

throwing the aspen into shade and hindering their growth; another decade, and most of the aspens have died out because, being light-lovers, they could not thrive in the shade of the pine, which has now recovered the ground it lost thirty years ago. An exactly similar alternation of trees can be observed in New York and New England, with the exception that there spruces usually play the part taken by pines in the Lake region. Undoubtedly other sections of the country might furnish parallel cases where trees have an advantage at the start which they lose later on in the rivalry with other species.

Attentive readers must have observed that the dangers threatening a tree are by no means over when the seed has found a favorable locality and developed into a seedling. Just as very few seeds ever sprout at all, so very few infant trees ever reach old age. A very large old tree takes up a hundred times as much room as a young sapling. This room must be provided by killing off the weaker individuals competing for it. A wood composed mainly of very old trees will show far fewer individuals to the acre than one stocked with young ones. But the crown canopy may be just as dense, and the amount of timber contained in it is apt to be far higher.

It would require a volume by itself to describe in detail the manifold conditions under which the warfare of the forest is carried on. We have, almost at random, picked out a few of the phases

which influence its progress. These illustrations were designed to impress upon the reader the fact that a forest, left to the undisturbed action of natural forces, does not remain unchanged from century to century, but is different to-day from what it was yesterday, and will be still different to-morrow. As the individual tree lives through various life stages, from infancy to old age, so the forest as a whole matures and grows old. But while the individual, when its limit of age is reached, must die, the forest has the power of constantly regenerating itself, so that its continuity may remain unbroken for countless ages. There are, to be sure, certain slow secular changes which may in the long run destroy a forest altogether. Thus the forests growing in the northern half of our continent in tertiary ages were destroyed by the long glacial winter. But that is a matter of many thousands of years. Humanly speaking, there is no reason why a forest, taking its vast extent as a whole, should not live forever.

Another important principle we have tried to impress by our cursory observations on the inner life of a forest: Multifarious and bewildering as the variety of its life phases is, the forest and the changes constantly going on in it are not the disorderly results of accident. In their astonishing complexity they are yet dependent on a few simple laws of nature. To the degree in which we understand these and their workings, to that degree we will be able to control their results. As we pro-

ceed in the consideration of the subject-matter of this volume, we will have frequent occasion to treat of the forest as subject, not to natural forces, but to control by the will of man, who may destroy, maintain, or regenerate it as suits his purposes. To understand clearly how such control is possible, we must bear in mind that it is done, not by suspending or reversing the action of the processes of nature, but by guiding and giving special directions to them.

Such guidance and control are possible only to men who have a knowledge of those natural processes. Not as if anybody now possessed or was ever likely to possess such knowledge perfectly. But even an imperfect knowledge gives us a means of exercising some influence. It is only within a relatively short time that a partial understanding of the life processes of a forest has been accomplished anywhere, and in America we are still far from knowing as much of our forests as the Europeans know of theirs. During the greater part of our history, we were very far from exercising an important influence on our forests. On the contrary, our history as a nation was far more intensely influenced and largely determined by the primeval woods. The manner of this influence by the forest on our national history shall be the theme of our next chapter.

CHAPTER III

THE FOREST AND MAN

THE bold navigators of the sixteenth century who gradually made the Atlantic coasts of our continent known to Europe had before their eyes hardly anything but the hope of discovering in the newly found countries stores of precious minerals. To the wealth of other resources they were almost entirely blind. But hardly had permanent settlements been established on the continent when the value of the forest became apparent both to the settlers and the home government. From a very early period, the British rulers had their attention directed to the management of the forests, particularly in the northern colonies, and the various disputes growing out of the attempts to regulate the exploitation of the woods were one of the causes that contributed to the estrangement of the colonists from the mother country.

To understand the attitudes of the parties to these disputes it is necessary to recall the views then held as to the proper relations of colonies to their central government. Nothing was farther from the minds of the authorities who promoted the establishment of colonies than a desire that the

latter should grow up into flourishing communities, able to produce enough for their own independent support. The home governments merely wished to get from the colonists certain commodities which could not be produced at home and which would otherwise have to be purchased in foreign countries. Thus, in accordance with this theory, Virginia and other Southern colonies were to supply England with tobacco and indigo; the middle colonies were to furnish peltry. New England was long considered the most useless of all "His Majesty's plantations," for most of its natural products were of the kind that must come into competition with the products of Great Britain herself. But it was hoped that its forests might furnish the shipping of England with those great necessities classed under the name of naval stores: ship timber, masts, spars, tar, pitch, and the like.

Since English navigation had increased so much, in the time of Elizabeth, the supply of these stores had been a source of constant and anxious care to the government. The British Isles themselves could produce practically none of it. Therefore it had to be procured elsewhere, and the principal sources were Norway and "the East Country," meaning the Baltic provinces. This was considered a very unfortunate circumstance, first because British exports to those countries were small and most of the stores purchased had to be paid for in bullion, but particularly because it made England dependent on the good will of foreign governments. Sup-

pose that in time of war those governments should prohibit the export of such stores, what would become of British shipping, both naval and mercantile?

For these reasons the government tried to induce the New England colonists to quit farming, and especially the catching of sea fish and the considerable foreign commerce built thereon, and go to producing naval stores. The colonists would have been ready enough to do so, though at first they knew nothing about the business and produced inferior qualities of tar and pitch, but they found it did not pay to sell their goods in England, notwithstanding a bounty offered by the government. A British vessel could make three trips to the Baltic or five to Norway during the time consumed by one voyage to New England. Consequently the cost of transportation made the sale of such goods in England unremunerative. But the colonists soon drove quite a lively trade in ship timber and masts, as well as other lumber, with the West Indies, and even with Portugal and Spain, to the horror of the British officials, who became indignant at the wickedness of people supplying foreigners with war material. Partly on account of the efforts of the government and partly through natural advantages and native enterprise, the lumber trade soon became a principal source of New England prosperity. As early as 1663, a sawmill was erected on Salmon Falls River in New Hampshire, and in 1706 no less than seventy were running on the Piscataqua.

This, however, was not what the home government had intended. They wanted to benefit Great Britain, not the colonies, and now England bought most of her naval stores in the East as before, while the colonies grew rich by supplying foreigners. Next followed a series of measures intended to restrict the trade in lumber and naval stores. As early as 1665 Edward Randolph was made "surveyor of the woods and timbers of Maine" at a salary of fifty pounds per annum. The office seems to have been a sinecure, for at a later time Governor Bellamont said that Randolph "never did a sixpence work." In 1691 the office of "Surveyor-General of the Woods" was established, covering all the provinces of which Bellamont was Governor. At first Randolph held this place, but a few years later his successor, Bridger, entered on a quarter-century of what the colonists considered "pernicious activity." His duties were to see that no masts were exported without a license; that no waste of timber was permitted; and especially that no trees reserved for the royal navy were cut. In the various grants of land by the government provisions were usually inserted reserving all pines of twenty-four inches in diameter at twelve inches from the ground. By the Massachusetts charter of 1691, the cutting of such trees on land not included in grants to private parties was also prohibited. The surveyor was to mark these trees with the famous sign of the broad arrow. The penalty for cutting a marked tree was

one hundred pounds. There were other regulations, designed to prevent wasteful lumbering, some of which were not ill-devised and might have been approved by the colonists had they been imposed for their benefit instead of that of the mother country. For instance, in 1705 a penalty of five dollars was provided for cutting "pitch pines or tar trees" of less than twelve inches diameter. As it was, all these regulations were cordially hated, and poor Bridger had a lively time of it. When he seized timber illegally cut, it was often rescued by mobs; juries refused to convict offenders on the plainest evidence; the marks on the king's trees were cut out by persons who, by way of adding insult to injury, put the broad arrow on worthless little runts. Bridger's life was frequently threatened, and he was accused of all sorts of malfeasance. Once he had to go to England at great expense to defend himself against charges of corruption. The Board of Trade, under whose jurisdiction he was, pronounced him innocent and he resumed his office. His successors showed no better results than Bridger in enforcing the laws, although it is said that they knew better how to make out of the office profits which would not look well in official reports. The irritation growing out of these laws did not cease until British dominion came to an end.

One of the causes of legitimate dispute regarding these regulations grew out of the vague and inconsistent character of reservations contained in

the various grants and charters. The colonial authorities in Massachusetts held that whenever a tract of land was established into a new township, the royal reservations lapsed, and the people of the new town could cut all the timber they wanted. The Surveyor-General construed the law differently. In the Maine district, especially, every new town meant a new sawmill, to the disgust of the Surveyor-General, who soon came to put all kinds of obstacles in the way of new settlements, and so added to his unpopularity.

The making of tar and pitch never amounted to much in New England or the middle colonies, notwithstanding the efforts of government to stimulate this industry. One of the most conspicuous failures in this line was the attempt to utilize the German Palatines in a scheme for the wholesale production of tar in New York. The experiment failed, principally for the reason that the contractors tried to treat the immigrants like serfs. That was not what they had come to this country for, and most of them left, to find independent homes in the Mohawk Valley and Pennsylvania.

While the mother country never obtained very much benefit from the American woods as far as the production of lumber and naval stores is concerned, it was very different with another product of the forests,—peltry and furs. While lumber was too bulky and too expensive in transportation to compete successfully in European markets with that of the Scandinavian and Baltic countries, furs

did not suffer on this account. A cargo of beaver and marten represented a vastly higher value than the quantity of lumber or naval stores a single ship could carry. But the manner in which furs were obtained was very different indeed from the production of other staples. It depended almost entirely upon trade with the Indians, and consequently the people engaged in this business could not confine themselves to the narrow strip along the coast where the settlements were, but had to penetrate deeper and deeper into the wilderness.

To the fur trader, therefore, is due the first knowledge the white man obtained of the interior of the continent. The French in Canada were on the whole far more successful in this branch of trade, largely on account of their better ways of dealing with the aborigines. To French *voyageurs* and *coureurs de bois* we owe the discovery of the country about the Great Lakes. But while they were the first to penetrate the interior of the great eastern forest, the inhabitants of the British colonies were not slow to follow. And there was this difference between the French and the people from the British plantations: the latter made permanent agricultural settlements wherever they went; the French established nothing but trading posts, with hardly more agricultural industry than that of the Indians themselves.

This slow invasion of the forest by the people from the seaboard resulted, at first, not in any very decided change in the forest conditions, but

rather in the modification of the character of the men who made their homes in these wilds. It created a type never seen before, a type which one must thoroughly understand in order to obtain a true notion of American history. This type was that of the backwoodsman, the product of the influence of primeval forest life on civilized Europeans.

It is very difficult for people of the present generation to realize what it meant, during the eighteenth and far into the nineteenth century, to take up one's home in the heart of the wilderness. It meant a practically complete separation from all the luxuries and most of the necessities of civilized life. As the forest closed behind the settler and his family, he knew that with the few simple utensils he had brought with him, his axe, his rifle, he must now manage to get for himself all he required. His clothing, his simple furniture, his food, his own hand must get from the soil of his little clearing or from the forest. A sturdy self-reliance was the first quality that such a life must foster. There was no possibility for the cultivation of the graces of life. All the virtues of the backwoodsman were those of a strong animal nature, courage, pertinacity, resourcefulness. His vices grew out of the same qualities. No doubt he was coarse, as was his life and his food. Not rarely, in moments of irritation and when the poisonous spirits he distilled for himself exerted their influence, he was brutal in the

extreme. But undeniably these people were men—no weakling natures were produced by the life in the forests. There was a strong love of adventure developed in many of these characters, which is evidence of a hidden power of creative imagination. At a later time, when the scattered forest settlements had grown into comparatively populous communities, this latent power came to the aid of the men who shaped the laws under which these new States were to live. For the laws and institutions of these western commonwealths had to be changed from those of the East not a little to fit the altered circumstances. The fact that the original immigrants settled on isolated homesteads sometimes miles away from the nearest neighbor had much to do with the unwillingness to co-operate with others for common purposes, or to submit to any kind of discipline, which later on was shown so often and sometimes with disastrous results by the people of the Middle West.

Among the people who took up their abode in the backwoods were men of all the nationalities represented in the motley population of the colonies. In the North, people of English descent predominated. But in Pennsylvania, Virginia, and the Carolinas the backwoodsmen were more apt to be either of German or Scotch-Irish stock. As these colonies were more immediately contiguous to the country west of the Alleghanies, it was in this section that the type of the backwoodsman developed in its greatest perfection. No matter what

the racial differences were between the settlers, the conditions of frontier life very soon moulded them into great similarity, so that the type was almost the same from the Lakes to the Gulf. In fact, the first white men, aside from the French, both in the regions towards the North and South, came from that middle ground of Kentucky and Tennessee where perhaps the type was most completely developed.

To what extent the peculiarity of civilization evolved in the early days of the States between the Appalachians and the Mississippi was the product of the forest surroundings becomes apparent when one compares the development of these States with those of the trans-Mississippi country. The place of the pioneer in the forest, with his axe, and his leathern hunting-shirt, travelling slowly on the rough trails or drifting down the rivers in canoe or flatboat, is there taken by the horseman of the plains. We cannot trace here the details of how this difference in surrounding nature has expressed itself in the laws, customs, and institutions of these sections, but to the attentive student of history it is plain indeed.

For a long time the writers of American history, mostly men of the Atlantic seaboard, almost entirely neglected the part played by the backwoodsman. Yet, now that our history is being treated with a more truly scientific insight, it is found that in many a crisis the peculiar character of this class exercised a determining influence. For one thing,

it is coming to be better understood that the great central fact of the first century of our national existence was the conquest of the continent, not the slavery struggle. Even in the latter episode, the backwoodsmen exercised the greatest influence, for their sympathies were about equally with the South and the North, and wholly for the Union · thereby the long era of compromise and delay was made possible, during which the strength of the North grew so much beyond that of the South that the final result could not be but what it was.

The culmination period of the backwoods type of American may be held to be the time from the Revolutionary War to the close of the War of 1812. By this time the various nationalities represented among the western settlers had been welded into homogeneity, and numbers of people had grown up that had never known any life but that of the forest. During this period men springing from pioneer stock first assumed leading positions, which they continued to hold long after the conditions that created them had been much modified. He who does not understand the backwoods type and sympathize with its primitive strength, notwithstanding all its crudeness, will never comprehend why Clay and Jackson, Benton, Cass, and scores of similar leaders during half a century commanded the admiration and affection of the greater portion of the American people, and why at the same time the eastern commercial and professional classes

never overcame their distrust of them. These men owed surprisingly little to the European tradition still powerful in the East. The roots of their being were sunk deep in the western forests. The influence of the boundless woods, with their long, dreary stretches of swamp land, and their majestic corridors of towering trees, had penetrated their minds on their long travels through the wilderness as circuit riders or military leaders. Though some of them, in the course of long public careers, became really men of wide education and broad minds, who could very well appreciate the points of view of people of different type, yet they never lost their affinity with the men whom they represented. The winds that rustled through the sycamores of the river bottom can be heard in the speeches of Henry Clay, and the odor of the pines hovers around Cass while he moves through the over-civilized circles of the East.

The race of backwoods statesmen has disappeared. Their successors obtain their training no longer in the Indian fight and the log cabins that served as court-houses. Their training-schools are the library and the university lecture-hall, and the counting-house, with which even the modern law-office has but too much in common. No doubt they will never be guilty of the lapses in good taste nor of the occasional naïve blunders their rude predecessors committed. But is it altogether for the best that the influence of the forest has been so far removed from our modern leaders that

they see its beauties, and feel its rugged strength, merely in the tourist's superficial attitude? However that may be, it is certain that to the backwoodsmen we owe the conception of an America extending throughout the continent, and even beyond, the ideal of a nation, strong, united, able to lead in the affairs of the world, and ready to assume such leadership when the opportunity offers, without timid deference to foreign objections. The generation which conceived this ideal passed away just as its realization was made possible by the new nation's baptism of fire, the Civil War; and as if it had been the special aim of Providence to set up a conspicuous mark at the end of the period when the forest-born generation had accomplished its task, the President who guided us through the tremendous struggle was the very personification of that class of men,—the backwoodsman glorified. In Abraham Lincoln all the repulsive characteristics of the type, its coarseness, its brutality, its self-will, had become gradually subdued through a long, steadfast career of ever-widening responsibilities. When, finally, the greatest responsibility was cast upon this man that can fall to the lot of an American, all the dross had disappeared, and nothing remained but the pure metal—strong, keen, tempered to perfection, and yet at other times as soft and pliable as gold without alloy. When from the lips of that man, already under the shadow of death,—although the throng that drank in his words knew it not,—came those sentences of the Second

Inaugural, which will ever remain among the most cherished words of human speech, who can tell how much of the pathos, devotion, strength, faith, and love dwelling therein had its birth from the forest influences that surrounded the youth in his father's cabin? Who will say that we exaggerate in maintaining that to the primeval woods, to the manner in which their strength and ruggedness, as well as their silent, tender workings, were mirrored in the minds and hearts of the men growing up in their shade, we owe that which makes us a people standing unique in the world's eyes, with an individuality and character all our own, for good and evil, not a mere feeble counterfeit of European models? Surely, if there were no reasons of practical utility and worldly prudence to make us care assiduously for what remains of our forest inheritance, it would behoove an American to give his best skill and endeavor to its protection out of gratitude for having moulded the men who first cast off the shackles of sectional narrowness and dependence on colonial tradition.

The task of opening the wilderness to white settlement, which had been the work of two generations of backwoodsmen, had, in effect, been accomplished when, after the second British war, the power of the Indians was broken. Henceforth it was no longer necessary for the adventurous settler to have his rifle in readiness while he wielded the axe. The hearts of the women in their lonely cabins no longer trembled at every noise which

their imagination transformed into the warwhoop of the murderous red man. From time to time an outbreak like Blackhawk's ill-fated enterprise still sent a tremor of dread through the western country, but these were like the dying reverberations of thunder when the clouds are sinking below the horizon. The throngs of immigrants now increased apace, and quickly the clearings multiplied; towns and villages sprang up, and the forests began to show the effects of human labors. But so strongly had the character of the first invaders been impressed by the forest life, and so closely was the resultant type adapted to the conditions, even aside from the exigencies of Indian warfare, that for one more generation the backwoods type remained dominant in the West. After all, though settlement increased fast, the western people still lived in lonesome, self-dependent isolation, between miles and miles of forest almost as untouched by civilization as when the first white man descended the western slope of the Alleghanies. The few clearings scattered here and there lay mostly on the uplands bordering the navigable watercourses, and had to be reached from the river by narrow trails across the tangled forests of the river bottom. It was out of the question to transport heavy goods over these trails, nor were the means of communication such that they encouraged frequent trips to town. Consequently, the settlers, during the slow process of hewing their farms out of the forest, lived almost in the same isolation as

the first invaders of the wilderness, and were compelled to rely for many necessaries on their own skill with the axe. From the forests they obtained all the material for the construction of their cabins, from the puncheon floor to the shingles on the roof, and the moss that calked the crevices of the wall. All this, together with the rude furniture, they cut themselves from the trees on their homesteads. The forests also supplied them with meat to vary the monotony of salt pork, itself made from hogs that found every bit of nutriment in the spontaneous products of the forest. When the first highways or "plank roads," were laid out, they were hailed with delight. Yet what poor substitutes for real roads these were; rough, sometimes studded with sharp rocks as they ascended a steep hillside, or, again, composed of equally rough logs laid crosswise, called corduroy, where a wet place had to be passed. Yet these were superior accommodations of travel, and most of the journeying through the woods had to be done by boat or on Indian trails.

A correct conception of what is meant by a trail in the forest has largely been lost by the descendants of those who a hundred years ago toiled along them into the western country. The fact that trails are laid down on some maps issued in pioneer days is apt to give the inexperienced an idea that they were some sort of rude attempts at roads, made artificially by the Indians. They were far from that. In places more than ordinarily frequented a faint trace of foot-path worn into the ground might be

discoverable, but generally the trail was nothing but a succession of landmarks. A spring, a natural meadow, a striking rock, a peculiarly shaped tree, these were the things which from time to time proved to the wanderer that he had not "lost the trail." Often it took all the skill and experience of the woodsman to find these marks, which sometimes were nothing but the faintest evidences showing that people had passed here before—evidences which by the novice in woodcraft could not be discerned at all. Far as these trails were even from the simplest idea of a road, they were by no means useless; for they generally led through the portions of the wilderness most easily traversed, avoiding as far as possible the impenetrable swamps and windfalls, and crossing the rivers at the best fordable places. Of more importance was the trail by proving to the traveller from time to time that he was not lost, but walking in the right direction. To those unacquainted with travel in the forest it is sometimes hard to understand the fear the natives have of getting lost in the woods, but a little experience soon convinces them and often throws them into the opposite extreme of an unreasonable horror of leaving the beaten path. It is frequently said that it would be an easy matter to get lost in a forty-acre piece of forest, and there is some truth in the statement. On account of the many fallen trunks one has to climb over or go around, and in places the dense underbrush, it is very difficult to keep one's direction. An experienced woodsman, of

course, can do so better than a greenhorn, and there are some helps furnished by nature herself. To follow the direction of the streams is good advice, provided you know where they are running to. Some of the counsels found in books are quite absurd. For instance, it is often stated that in the absence of sunshine one can tell the points of the compass by the lichens and mosses on the tree trunks, which are always thickest on the side of the prevailing winds. What good do the points of the compass do one who does not know in what direction his destination lies? Besides, this sign may be true of trees in exposed situations, but not of those in the sheltered depths of the forest. At any rate, to be lost in the woods is a sensation which no one that has once had it even for a short time will want to repeat. One often hears the statement that nobody was ever lost for more than twenty-four hours without suffering a derangement of mind, and I believe there is a certain amount of truth in it. The oppressive sense of utter loneliness, the fear of hunger, and the actual suffering from hunger and fatigue may undoubtedly exert a destructive influence on all but the strongest minds. Nor are actual dangers entirely absent. As a general thing our American forests, at least on the east side of the Mississippi, are not infested by animals fiercer than the black bear, who is very careful not to get into trouble with a human being. Yet there are even recent cases of people, especially children, being attacked by wolves. Some eight or ten

years ago, for instance, the children of a settler living a few miles from a town in Central Wisconsin, a little girl of eight and a brother two years younger, went picking raspberries. When they had not returned by nightfall, the parents became anxious and summoned the neighbors to help search for them. But no trace was found. The next morning the people of the village were notified. At once the sawmill was shut down and the whole male population went to the woods to continue the search, while the women were busy providing food for the searchers. All efforts were vain. A band of tramping Winnebago Indians who happened to be in the neighborhood were arrested by the sheriff on suspicion of having stolen the little ones, but of course there was no evidence of this. Several months later a woodsman found the remains of the unfortunate children in the densest tangle of a windfall, with the clear traces that wild animals, probably wolves, had attacked and partially devoured them.

Let us return to the early settlements of the western forest. The lack of transportation facilities was the chief reason why for nearly a generation after emigration into this section had begun in earnest, the condition of the settlers remained that of backwoodsmen rather than farmers. They were still directly dependent on the forest for nearly all the necessities of life, and the forest still impressed its indelible stamp on their character, while they produced but little change in the conditions

under which the woods had existed for countless ages. The change came with the advent of that great revolutionizer of economic and social conditions, the railway.

The steamboats which came several decades before the railroad had not by any means changed the conditions of western settlement to the extent one might expect at first glance. They made migration from the Alleghanies to the remotest portions of the Mississippi Valley a great deal more easy, and therefore were an immense stimulus to increase of population. But they were rather calculated to restrict settlement still more to narrow strips along the river valleys than had been the case in the old days of canoes and flatboats. In the prairie regions, of course, locomotion was comparatively easy. This, together with the easier mode of clearing such lands for agriculture, gave those sections a great advantage over the heavily timbered portions. So it came about that those parts of the Middle West which were continuously wooded, in the same manner as the East had been originally, did not come under the influence of the various waves of settlement until railroads began to be built through them, and here true backwoods conditions lingered long after a new era had begun in the prairie sections. To-day, the last trace of the backwoodsman is found on the mountainous portions of the South, such as Eastern Tennessee and Kentucky, or parts of Arkansas. But like all remnants of the types of former epochs, it is a

degenerate relic. The latter-day backwoodsman has the poverty, the ignorance, the lack of civilized ways which we found in his predecessor, to an exaggerated degree. But he lacks the spirit of adventure, the state-building genius, which made the old generation so important a factor in our national life, and above all the energy which enabled the men of 1812 to lay the foundations for an enduring civilization. The railway, which gave his predecessor an opportunity to grow, is reaching him also, and the question is: Will he be able to seize the chances offered, or will he disappear from the face of the earth?

Since the building of railways through the forest began, the dominion of man over nature has been established there, as it has been on the prairies and the plain. Settlement now invariably follows the railway lines, forming a strip extending a few miles on either side of them. The conditions under which newcomers now make their homes in the forest are very much easier, indeed, than they used to be in the old days. Scores of things which the backwoodsman had to provide for himself as best he could, the modern settler buys at cheap rates in the railway town: windows, doors, sawed lumber of all kinds, hardware, furniture—no less than clothes and a hundred luxuries which his predecessor never dreamt of having. The modern settler is a link in the great chain of world-wide commerce, where the backwoodsman was an isolated being, having to produce almost all he needed with his own hands.

While thus the immediate dependence of the settler upon the forest has greatly declined, indirectly the forest is perhaps of just as much importance to him as it ever was. Certain it is that at no time in our history has the forest been of so much importance to us as a nation. The immense increase in the business of lumbering dates also from the time of the advent of railroads. The lumber industry, in all the forest region where settlement has gone forward during the present generation, has been the main support of the settler. Making a farm out of the primeval forest is slow work. On the prairie you have but to break the sod, and can get a crop for sale the very first season. In the woods you cannot expect to raise field-crops for sale till after a number of years. Therefore the forest settler would have had no money wherewith to buy the commodities brought within his reach by the railway, and would have had to go on in the old backwoods life, if it had not been for the wages earned in the lumber industry.

As long as practically all the settled portions of the United States were in the close neighborhood of extensive forests, there was little trade in lumber within the country. A few small sawmills provided all that was needed for home consumption in each neighborhood. The country people lived to a great extent in log houses of their own fashioning and considered sawed lumber as a luxury beyond their reach. Only along the seacoast, especially in Maine, New York, and New Hampshire, was

there a lumber industry intended for consumption away from home. When timber fit for construction purposes had become exhausted in many places, such lumbering on a large scale became a necessity, and from that time on the relations between man and the forest underwent a revolution. Hitherto the forest was the dominant element; man had to adapt himself to its nature if he wanted to sustain life within it, and the strange backwoods type of civilization was the result. Now man became stronger than the wilderness. He began to carry all the appliances of his industrial and commercial life into the very depths of the forest. Partly through his deliberate intent, partly by means of unintended consequences of his acts, he disturbed the life processes which had for many ages determined the character of American woods, and created new conditions to which the forest, or so much of it as was not directly destroyed by the invaders, had to adapt itself or perish.

The men who wrought this change were the sons of the backwoodsmen. Not a few of them had themselves spent their youth under backwoods conditions. It was not surprising that they did not at once realize the changed relations in which th stood to the forest. The backwoodsma sure, derived his sustenance from the wo s, bu he did so by destroying them. To his eyes, th fall of a tree was the rise of civilization. The ugly, repulsive look of his clearing, with the fire-blackened stumps, or worse, the tree trunks still standing

upright but killed by girdling, the unkempt, rude aspect of his cabin, were for him the cheerful signs of victory over hostile nature. The woods were to him something to be got rid of, if such a thing was possible. There was for him no sentimental regret over a felled forest giant, no elegiac tones in the song of the axe. But on the other hand the forest was for him a fact of most stubborn character. He had travelled through it, slowly toiling along the trail, carrying his pack of provisions to sustain life, or gliding down the interminable windings of the river. He knew how large it was. East and west, north and south, he knew that forest extended for hundreds and hundreds of miles. He was but too well aware what slow work it was to make a clearing but a few acres in extent, that would hardly be noticed in the vast expanse of woods. The idea that the area of this forest could ever be diminished by human hands to any appreciable extent, so that people would become afraid of not having woodland enough to supply them with the needed lumber, would have seemed an utter absurdity to him. To be sure, where settlers came in thick and fast, the forest might disappear and farms take its place; but then there would always be plenty of timber a few miles farther on. Thus the legend arose of the inexhaustible supply of lumber in American forests, a legend which only within the last twenty years has given place to juster notions.

It would have been too much to expect that these views with regard to the forest created by three

generations of backwoods life would not influence the manner in which the lumber industry was carried on. No doubt it would have been well for the American people if the better methods of felling, methods that had a conservative regard for the reproduction and continued existence of the forest, could have been adopted when lumbering on a large scale first began. But such a thing was impossible. It could have been done if the pioneer lumbermen had known what we know now,—that the natural supply of lumber would be sufficient for our needs for less than a hundred years. It could have been done, above all, if those pioneers had held the same attitude to the forest which we hold, who live in cities and among well tilled fields. We stand on the outside, and can see many things which they who dwelt within the forest could not see. Remember that those pioneers were the sons of backwoodsmen who had struggled for life with those very forests we blame them for destroying.

Let us not quarrel with that sturdy race for the harm they have unintentionally done us, for we owe them too much. Remember that hundreds of cities, from Pittsburgh to St. Louis, and a million rich and smiling farms, are lying on the grounds where our backwoods predecessors counted each tree that succumbed to their axes a victory for civilization.

Times have changed, and the tasks of this generation are different from those of the last. Their duty was to make room for human life where wild

nature reigned supreme. Ours it is to bring conquered nature into harmony with the higher, fuller life of humanity, lest the roots of that life be severed and die. Woe unto us and our posterity if we fail to do our duty as well as our fathers did theirs!

CHAPTER IV

THE FOREST INDUSTRIES

NEXT to agriculture the forest industries stand first in importance to the people of the United States, while the various forms of mining, including such occupations as brickmaking and the like, rank but third. By forest industries I mean, not merely lumbering, but all those industries which obtain from forests either finished products for consumption or raw material for manufacturing branches. It would be useless to insert in this book columns of statistics to illustrate these facts. Those who care to study them can find them easily in publications printed for that purpose. Nor can we attempt to give a complete enumeration of the various products which besides lumber are furnished by the woods. A few of the most important ones we may specify, and each reader will find it easy to add to the list.

First, there are a number of things of widespread use which are very apt to escape the census taker altogether because they are mostly made on a small scale for local consumption, not rarely by the consumer himself. Such is fencing material of all kinds. The old-fashioned zigzag rail fence

is not yet a thing of the past. The modern wire fence may gradually supplant it—but that also needs posts to hang it on. Since fencing has gone forward on the treeless plains, a large trade in fence posts has even sprung up to supply this demand, while formerly fence posts were mostly used in the neighborhood where they were cut. Telegraph poles are another minor article of forest industry which yet is of large proportions in the aggregate; so is the supply of long logs for piles under the foundations of buildings. Railroad ties are consumed at an ever-increasing rate. Hop poles, bean poles, Christmas trees find ready sales in many places. These and various other products of the woods have the peculiarity that even in this age of machinery and production on a large scale they are still, to a very great extent, supplied by the labor of individuals armed simply with axe and hand-saw. To the settler in forest regions the ready market he finds for such articles is a very great help during the period when his clearing has not yet become a farm, and even when agriculture proper has become his main occupation he can make many a dollar of cash by work of this kind in his timber-lot during unoccupied intervals. Shingles are now usually made by machinery, but in many parts of the country it still pays to make them by hand for local consumption.

Charcoal making is a forest industry which employs not a little capital and a great many workmen. It is still, to a great extent, carried on by

the primitive process of the old-fashioned kiln, but better methods are now being introduced. The making of wood alcohol and other products of dry distillation is an increasing business, and while the market for such wares will always be limited, the demand must increase with the progress of the industrial arts in which such things are used. The ancient industry of making pitch and the like is flourishing in many parts of the southern pine regions, as is the making of turpentine, which is produced mostly from the long-leaved pine of the South. While the forest products just mentioned have been known to man for thousands of years, modern industrial civilization has added a number of entirely new forms of utilizing forest products. One of these is the making of excelsior, the narrow strips of shavings which everybody now knows as a packing material. The making of boxes and packages of all kinds, from heavy dry-goods cases to the little thin-walled berry boxes, has also become an important industry within quite recent years, and opened a market for many kinds of wood, such as poplar, which was formerly considered quite worthless. But the most astonishing case of the rise of a new industry is the making of wood pulp for paper, which was quite in its infancy twenty years ago, but now produces goods of the value of more than a hundred million dollars annually. There are two methods of making wood pulp, one by mechanical grinding, the other by the application to the wood of various acids and

other chemicals. In both of these processes the wood most largely used is spruce, but poplar, basswood, hemlock, and several other kinds also enter into the consumption.

A very important product of forest industry is bark for tanning purposes. There are in the United States a number of trees the bark of which may be used in making leather, notably several species of oak. But by far the most important tree of this kind in North America is the hemlock. The hemlock industry, by the way, furnishes a striking illustration of how the American forests have, since the coming of the railroads, been drawn into the circle of the world's commerce. One of the centres of tan-bark production is the eastern portion of Central and Northern Wisconsin. Within a few years large tanneries have there been set up in the very midst of the forest, and raw hides are brought there from Argentina to be treated with the bark of the trees growing near by.

Side by side with the wood-pulp and the tan-bark industries,—each of them in a different way illustrating phases of the most modern economic development,—the most primitive of all forest industries still remains one of the most important of all. That is the cutting and consumption of fire-wood. Although there are many places, even within heavily wooded territory, where the use of coal and various kinds of fuel has almost entirely superseded the use of wood for heating and cooking purposes, yet it is probably correct that an

overwhelming majority of the American people is still dependent on this most primitive of all fuels. This refers especially to the rural population, but also in a large degree to the villages and smaller cities. Statistics leave one utterly in the lurch when he tries to realize the extent of fire-wood consumption: for the greater portion of it takes place in the homes of the producers themselves, while wood which is sold goes ordinarily direct from the man who cuts it to the person that uses it. Consequently there is no middleman to whom the census taker could apply for information. Generally speaking, the price of fire-wood is limited, in this country, to the cost of cutting and hauling it. But there are exceptions in favored localities, especially near large towns. For instance, the management of the celebrated Biltmore forest in North Carolina, which will repeatedly be mentioned in these pages, has during recent years made enough out of the sale of fire-wood to pay the considerable expense of managing that property according to silvicultural methods. In some parts of the country the railway locomotives are still using wood for fuel, and in a few manufacturing branches wood is preferred to coal.

Turning now to the lumber industry proper, we must distinguish between two principal branches of it, which almost, though not entirely, coincide with the popular distinction between hard woods and soft woods. Among hard woods are included the kinds of lumber coming from broad-leaved trees,

although some of these, like basswood and poplar, are not at all hard when treated with cutting tools. Several species of hard wood are widely used in building, for floors, wainscoting, and interior finish in general. But the larger portion of this branch of lumber is consumed in the various manufacturing industries, such as furniture making, carriage building, and the like. The other great division of lumbering is the production of building timber, obtained principally from coniferous trees and indiscriminately called soft wood, although some kinds are harder and heavier than many woods from broad-leaved trees. Of this the American people consume larger quantities than any other nation, for the reason that houses built mainly of wood are still the rule with us, while in Western and Central Europe wooden houses are practically unknown. On account of our prevalent fashion of building "frame" houses, we consume most of our lumber in the shape of boards. In Europe, so far as wood enters into the construction of house walls at all, it is used in the shape of beams, while the use of boards is confined principally to floors and other interior work. These facts are important to know when one attempts to compare the lumber industries of two countries, and their neglect would lead to very erroneous conclusions.

It may be said here that while we have much to learn from several European countries with reference to the continued maintenance of forests, and proper methods of silviculture, we need not go to

school with them in anything which concerns the lumber industry proper, the transporting and sawing of logs. Our appliances for transportation, aside from permanent roads, which we do not need as long as we do not care for forest reproduction, are far superior to those employed in Europe; the machinery of our sawmills causes admiration and astonishment to the foreign expert. When one visits our lumber towns he may at first wonder at the apparent waste, and ascribe it to crude methods, when he sees the immense accumulation of waste material, "slabs," and other debris encumbering the ground. But in reality everything is utilized for which there is a market or a use. Even the sawdust often serves as fuel in the mill, and is transported automatically from the saws to the fires. If there is some material thrown away which is saved in a European mill, it is because nobody will have it, just as, in felling, we must lose the tops and smaller branches, while the European lumberman binds them into faggots and can sell them for fuel.

The occupation of a lumberman, his life in camp and on the river drive, has a certain picturesque quality which has always made it attractive to the outsider. But before we attempt to sketch in outline some of the striking phases of this business, we ought to discuss two questions of very great importance to a proper understanding of the matters with which we have to deal. These are: How long will American forests be able to supply the demand for

lumber? and to what extent is it likely that substitutes will be found for the use of wood?

In the preceding chapter we have spoken of the legend, formerly so widely believed in, of the inexhaustible supply of merchantable timber in the primeval woods of the country. That story is no longer credited, and even the lumbermen are fully convinced now that the giving out of the original material is a mere question of time. Nowhere in North America is lumber fit for general building purposes cut from second-growth timber, that is, from timber which has grown from seedlings since the original trees have been removed. Where a second-growth crop of pine and other conifers is now harvested, it is being used in various manufacturing industries. Where lumbermen, cutting construction material, speak of "second growth," they merely refer to timber which they left standing thirty or forty years ago because the trees were then too small and they culled only the larger individuals. Exhaustion of timber supply, therefore, is, under present conditions, identical with exhaustion of the supply found in virgin or primeval forest.

A distinction must be made between exhausting the lumber supply of a whole country and that of a particular region. The former would be an undoubted national calamity; the latter may, under some circumstances, be a benefit. In the second part of this volume, when we come to speak of the manner in which our forest resources ought to be

treated, we will have to impress upon the reader the importance of the principle that forests, unless for protective purposes, ought not to be maintained on land which could be utilized in a different way with greater profit to the owner. Therefore, it is not to be regretted if a region of great agricultural capabilities ceases to supply lumber and becomes a farming country. But it is otherwise where an area is denuded of its merchantable timber and henceforth lies as an idle waste, stocked at best with scrub and inferior species of trees—weeds, as the forester calls them. Unfortunately, a large part of what was once magnificent white pine forest is now in that condition. The eastern part of the white pine area, Maine and the rest of New England, New York, Pennsylvania, has long ago ceased to play a large part in the pine lumber market. The bulk of the white pine now produced comes from the Great Lakes country. But here, also, the end is near. In Michigan, where, twenty years ago, Saginaw was the centre of the greatest lumber industry in the world, the year 1882 marked the climax of the output. A rapid decline followed, and to-day Michigan pine lumbering on a large scale is practically at an end. Wisconsin reached its greatest output just ten years after Michigan. It still produces a very large quantity every year, though much less than in 1892. According to the most reliable estimates, it may still be an important factor in the pine lumber market for ten years, and then the end will have come here also. Minnesota

is now the State in which the greatest quantity of merchantable pine is to be found. How long it will hold out is uncertain, but hardly more than twenty years, even with somewhat reduced output.

What will be the consequence of this exhaustion of white pine lumber? To the States immediately concerned it will mean that thousands of people who have made their living in the pineries and sawmills will have to go elsewhere; that others who have prospered by supplying the wants of the lumber crews must do the same or go into some other business. To some extent, agriculture will take the place of lumbering as the principal support of this section, but not altogether; for many large tracts from which the pine has been cut are quite unfit for farming. Even now there are in Michigan and Wisconsin many places, thriving villages and little cities fifteen years ago, which are now almost deserted, with the houses falling into ruin. The pine timber of the neighborhood has all been cut, the sawmill shut down, and with it prosperity disappeared.

Taking the country as a whole, the consequences of white pine disappearing will not be quite so bad. The place of this material will be taken, for all ordinary purposes, by the various kinds of southern pine, especially the long-leaved species (*Pinus palustris*), commonly called Georgia pine. This has already been done to a considerable extent. This is the reason why there has not been an appreciable rise in the price of white pine for lumber,

notwithstanding the comparative scarcity of the material. How long the supply of the southern pine will hold out, nobody can foretell at present with any degree of certainty. In the first place, no one knows just how much there may be standing, and secondly, nobody can guess what the future demand may be. It may go on increasing at the tremendous rate at which it has done during the last quarter-century, or it may remain comparatively stationary. Probably the extreme limit, however, for supplying the market with original southern pine on a large scale is fifty years.

Whether the western conifers, the sugar pines, Douglas spruce, and other species, many of which produce construction lumber second only to white pine, will ever play an important part in lumber markets east of the Rocky Mountains is doubtful. They now supply the demand of the Pacific coast and several foreign countries, notably Australia. But it may be that the cost of transportation will keep them out of the eastern markets, even after the Nicaragua Canal shall have established cheap communication with the Atlantic seaboard.

As to hard-wood lumbering, the centre of that industry is now the great middle region, about the latitude of Kentucky and Tennessee, where the broad-leaved forests of the United States reach their finest development. However, there is also a great deal of hard-wood lumber produced in Michigan and Wisconsin, and even such comparatively deforested States as Ohio and Indiana still contribute

a generous share. Much of the hard wood of the country is still annually wasted, for want of a market. Many thousands of logs that ought to bring good prices and be made into furniture and other manufactured articles are used as fuel, or, worse, burnt up by the settlers in clearing simply to get rid of them. With increased transportation facilities such waste will largely cease, and the hard-wood forest will for a long time to come increase as a factor in the industrial life of the country. This may be a good place to call attention to the fact that we are naturally far richer in lumber trees than our European friends. This is true of both soft and hard woods. In Europe there may be about a score of trees which are of commercial importance. In the United States and Canada there are nearly five hundred indigenous trees. Of these about a hundred are of such quality and occur in such numbers that they may fairly be classed among the industrially useful ones. This list is constantly increased as trees heretofore neglected come into use and gain a place in the lumber markets. This happened, for instance, to the sweet-gum (*Liquidambar styraciflua*) within quite recent years. The same thing is true of the cotton-wood (*Populus monilifera*), which was formerly considered useless, but is now largely cut for packages.

Whatever may be true of the hard-wood industry, the supply of soft-wood lumber, which for the present, at least, is of the greater economic importance, cannot last longer than half a century at

most. It should not be understood that after the time which we have above set for the disappearance of the white pine, together with the Norway and hemlock which are lumbered in the same area, not another log of merchantable size will be cut there. On the contrary, some white pine, for local consumption or special uses, will continue to be produced, but it will not be enough to cut a figure in the lumber markets of the entire country. The same is true of the southern or yellow pine supply. This refers, of course, to the cutting of virgin pine. If we could proceed to cut the second growth after the original material is consumed, we would have no trouble. But such a thing will not be possible if we merely trust to the natural reproduction without taking the steps to promote and protect such reproduction, which will be treated of in the second part of this book.

The only other way out of the dilemma will be to substitute for the use of lumber in construction other materials, wherever that is possible. We cannot rely on importation from foreign countries for the reason that there is nowhere a source of supply of building timber even approximately adequate to our present demand. It should be observed that we consume annually about four times as much lumber per capita as England, and three times as much as Germany. That this will have to be changed during the next fifty years, there can be no doubt, even if we adopt a policy of systematic timber culture during the next decade.

Now to what extent is it possible to substitute other materials where at present we use soft woods? To a very limited extent it will be feasible to substitute hard-wood lumber, as, for instance, poplar for pine in the making of boxes and packages. This is already being done to a considerable extent. But then that means only deferring the evil day of lumber famine a few decades, for it will make the hard-wood forests disappear the quicker. For the erection of buildings, sidewalks, bridges, and similar structures, the use of stone, brick, and iron of course suggests itself. Stone and brick are the almost exclusive building materials of Europe, and in our larger cities these materials, together with the iron used in large edifices, are rapidly driving out the typical American "frame" houses. Not unlikely the latter will have practically disappeared from the United States in the course of fifty years. If so, it is by no means a thing to be desired. Stone and brick houses are no doubt more lasting and substantial than wooden ones, but also far more expensive. If the average American family of small means in the future will not be able to obtain the cheap and commodious frame dwelling in which it lives to-day, that will mean a long downward step in our standard of life towards the European level. It will mean the spread of the tenement house from a few large cities to the small towns, the disappearance of the one-family cottage, with its lawn and garden-patch, from the villages. It will mean the loss of one of those advantages by which

we have kept our economic superiority to the older countries, another widening of the rent between the rich and the poor, another difficulty thrown into the path of a democratic form of society.

But even if we accept the necessity of restricting the use of lumber in construction, there are many other uses of wood where a substitute cannot be found at all. Such uses will easily suggest themselves to the reader: aside from furniture, he will think of boxes and packages, various household utensils, and other things consumed in great quantities by every civilized society. One very important use, in which no substitute for wood is likely ever to be found, is the consumption of mining timber. Wherever mining is carried on underground it becomes necessary to shore up the walls and ceilings of the galleries with timber to keep them from caving in. This necessity is one of the heaviest sources of expense in most mines, and a constant supply of cheap timber is necessary to their running. It is not apparent what substitute could ever be employed for such and similar purposes, so that the disappearance of timber supply would be a death-blow to the mining interests.

It is clear, then, that the maintenance of a supply of timber, both of the soft- and hard-wood kind, remains a vital necessity of our economic welfare, even if our present rate of consumption is greatly diminished in the future. It is also undoubtedly true that we cannot rely much longer on a supply furnished by the original forest in the way we have

done heretofore. The forests are rapidly disappearing, or where they do not disappear entirely they deteriorate so as to lose the power of furnishing timber of commercial value. Fortunately, it is not impossible to so change our ways of treating the forests now in existence that they may continue indefinitely to supply us with their products. By doing so we will at the same time protect ourselves against certain dangers to our physiographic and climatic conditions which excessive deforestation brings in its train. These dangers will be discussed in another chapter in connection with the means that should be adopted to prevent the impending famine. But before we proceed to this part of our subject we ought to attempt an outline picture of the manner in which the lumber business has been carried on in the United States since it first assumed large proportions.

There are few legitimate branches of business, not consisting of mere speculation and manipulation of stocks, in which such large fortunes have been made by individuals during the last fifty years as by the lumber industry. At the same time few branches, aside from agriculture, have been so instrumental in building up the general prosperity of the sections in which they were carried on. The foundations of these large fortunes were laid in days when the scale of operations was small and a man needed but a few thousand dollars to begin. At the present time, all lumbering conducted as a business by itself is done on a very large scale indeed, mostly by

corporations the capital of which often amounts to millions.

The first sawmills built in the Great Lakes region and elsewhere were small affairs, driven mostly by water-power and intended to supply local demand. Sometimes they were run in connection with grist-mills. People of the neighborhood would bring logs cut on their farms to the mill, and have them sawed into boards, paying a toll, as they would for the grinding of grain into flour. When sawing on a truly commercial basis began, it was done to supply the demand for lumber springing up in the cities that began to grow all over the Mississippi Valley. This new demand soon exhausted the timber supplies of the immediate neighborhoods and made it necessary to go to comparatively remote places to cut the logs required.

The history of the modern lumber industry may be divided into two periods, with well marked characteristics. During the first, the sawmills were as near as possible to the places of consumption, and the logs were brought long distances to the mills. During the latter, it is more economical to saw the lumber as near as feasible to the place where the logs are cut, and transport the sawed material to the place of consumption. The change from one method to the other is marked by the advent of the railway, aided by the great improvements in mill machinery, which make it possible to erect sawmills in the very heart of the forest.

The first period is the heyday of the "river towns" all along the great streams tributary to the Father of Waters. In those days, when the notion of inexhaustible supplies was still universal, the lumbermen were fastidious indeed as to what and where they would cut. They would take only the largest and soundest pines, in localities near the big streams, where logs could be carried to the water's edge at the smallest possible cost. The transportation down to the mill was then almost universally done by rafts. Every large river was covered with these rafts, composed of pine logs fastened closely together. The occupation of the raftsman who guided these immense floats down the river, over sand-bars and through rapids, was one that required unusual skill, daring, and strength. The journey from the pineries to the mill sometimes occupied many weeks, and was accomplished quicker or more slowly according to the stage of water. The dangers both to the raft and to the men floating it were various, and many a poor fellow has been sucked under the logs by the current and drowned in a vain endeavor to release a raft from some rock or other obstacle in the channel on which it had stranded.

At the present time, rafts of logs are rarely seen on the rivers of the West, except on the Mississippi, and also occasionally on the Great Lakes. The modern rafts are apt to be even larger than those of the olden time, and are usually towed by steamers, one forward and one at the stern to keep it

straight in the channel. The greatest rafts ever constructed have been on the Lakes, but this is not the usual way of transporting logs there. The risk of the rafts breaking up and the logs scattering in a high sea is too great. Since the pine growing in the immediate neighborhood of the rivers large enough for rafting has been cut, the lumbermen have gone up to the very headwaters of the streams and along brooks of the smallest kind. On these the logs cut during the winter are floated down loosely, taking advantage of the high water when the snow melts. Usually the freshet caused by frequent rains in June is relied on to drive down the logs which were not brought in by the early high water. But of recent years much complaint is made that the June freshet fails.

When the logs coming down the smaller streams reach the main rivers, those belonging to different proprietors are very apt to become mixed. To make the severing of property of different parties possible each log is identified by the mark of its owner. These marks are registered in official records, kept by the proper State officials. To facilitate the sorting of logs belonging to different people, arrangements have been devised known as booms. These may be described as lines of anchored logs floating on the water, by which the river is divided into various compartments. The ends of these compartments can be opened and shut. If the lower end is shut, no log can float out. If the upper end is closed, none can come

in. As the logs come floating down the stream, men armed with long "cant hooks" guide each into the compartment in which it belongs. The booms are usually maintained by corporations formed for that purpose, which charge a toll for the services rendered by them.

Booms are not the only structures used on the logging rivers to facilitate the "driving." On all the smaller logging streams the loss by logs stranding on account of insufficient depth would be so great as to make the business unprofitable if dams were not erected at intervals to produce an artificial head of water. When a sufficient number of logs are collected above the dam, the gates are opened, and down they rush, pell-mell, the artificial freshet being sufficient to carry them far down the stream.

When the logs reach the mill, they are confined in a boom similar to those used for sorting, and out of this they are drawn up to the saws by an endless-chain arrangement. A modern sawmill is a very ingenious piece of mechanism, in which one of the most remarkable things is the extent to which the expensive handling of the material by men is avoided through the use of endless chains, inclined planes, and other appliances of automatic carriage. Now that most sawmills are no longer located in the cities, far away from the forest, their site is often on one of the lakes, large and small, that dot the pine country of the old Northwest, and these lakes do away with the necessity of a boom. Often a small lake is completely covered

with logs. The larger mills now usually run day and night during the season, since the electric arc light has made it possible to do this. Very often a planing-mill stands next door to the sawmill, so that the raw lumber may at once be finished. The grading and sorting of lumber, that is, its classification according to quality, is one of the most difficult tasks of the skilful sawyer, and can be well done only after long experience. There are very many grades of lumber recognized in the markets, and unfortunately no great uniformity prevails. The various grades are known by technical names, such as clear, select, culls, and the like. They are based principally on the freedom of knots and the texture of the wood, especially the proportions of sap- and heart-wood. The average quality of the lumber reaching the market has very much deteriorated during the last twenty-five years. During the early days, when the profits of lumbering were much higher on account of the abundance of material in easily accessible places, only the best trees were taken. At present the lumberman brings to the mill every stick of timber out of which a board can possibly be cut, and naturally much of this stuff is knotty, crooked, and sappy.

While in the old days the lumberman was confined to the neighborhood of logging streams, because it would not pay to haul logs far on land, this is no longer true. Now, when there is no convenient river to float his logs, he builds a railway into the heart of the pinery. Somewhere

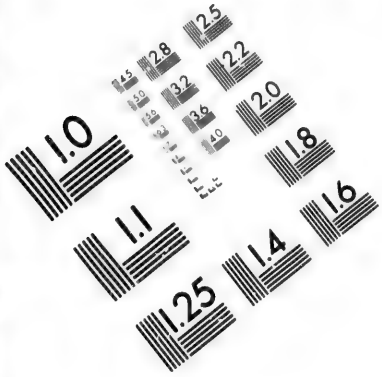
along this road a sawmill is set up. The road serves both to carry the logs to the mill and the lumber to market. These logging railroads are of the roughest kind as to roadbed and equipment. They serve their immediate purpose, however; and sometimes, after the timber which they made accessible has been removed, they become regular railways to supply the traffic of the settlements which may have sprung up in the meantime.

As the pine timber has become scarcer and scarcer in the easily accessible places, it has, of course, become more important to know just where to find it. This has given rise to a peculiar class of people variously known as woodsmen, cruisers, land-lookers, whose business it is to give information as to the existence of pine timber, its location, amount, value, and everything else that a party seeking to buy "stumpage"—that is, standing timber—must know. These men have a remarkable acquaintance with large portions of forest, sometimes covering almost a whole State. Their information is usually recorded in maps drawn by themselves in little books made for the purpose—little blank books that can be carried in the pocket, each page usually arranged to cover one section of land. As the information contained in these books is the stock-in-trade of the cruiser, he is rather jealous of divulging its contents, for which he ought not to be blamed. Often he is in the permanent employ of a lumbering or other corporation owning timber lands; at other times he is in independent business,

selling his services to whosoever wants them. Very often the woodsman combines other forms of woodcraft with that of looking up timber. He may have charge of a logging crew as foreman; act as "scaler," that is, measure the amount of logs cut by some contractor; show land to intending settlers. Sometimes he condescends to act as guide to a party of sportsmen, and lucky the tourist who can get a man of this kind to introduce him to forest ways; he will learn more in a day than he could without him pick up in a month. As a class, these woodsmen are of remarkable intelligence and have a great stock of empirical information regarding such matters as fall within the immediate scope of their business. It is a strange fact that notwithstanding this intelligence and knowledge, and the great opportunities they have had for speculation in pine lands and stumpage, these cruisers rarely become wealthy. Very few of the great lumbermen have risen from their ranks. It seems as if their constant life with unsophisticated nature kept them from acquiring that worldly shrewdness which is indispensable for success in money-making.

When a lumberman, acting on the information of his woodsman, has acquired a body of merchantable pine, he sends a small crew into the woods to make preparation for the winter's cutting. A camp is built of logs; rough "tote" roads are made on which supplies for crew and cattle can be taken into the woods; and with the first cold weather work begins. Practically all felling for

lumber is done in the winter, as far as the pineries of the North are concerned; only hemlock is cut in summer, because the bark, which is of more importance than the lumber, must be handled at this season. Work in the lumber camp is not an easy matter; it takes skill as well as strength and endurance. When a tree has come to the ground, it is at once cut into logs of the usual length, leaving as waste the branches and so much of the upper part of the main trunk as is below log size in diameter. The logs are rolled on skids to be hauled to the river bank or the railway track, as the case may be. The animals used for hauling are now mostly horses, but formerly oxen were almost universally employed. Very deep snow is undesirable during the cutting operations, but absence of snow would be a calamity, because only snow, or ice produced by flooding the road in cold weather, can make the rough logging roads passable for the heavy loads. The men employed in this work were in former years nearly all experienced men who made lumbering a business. Since the industry has assumed gigantic proportions, the lumbermen have been obliged to hire numbers of inexperienced laborers, whom they find in the large cities and take into the woods in gangs. These men do not get as high wages as experienced ones, and a few of the latter, besides the foreman, are a necessity in every crew. The commissary department and the cook at the head of it are important parts of every lumber camp. Work of this



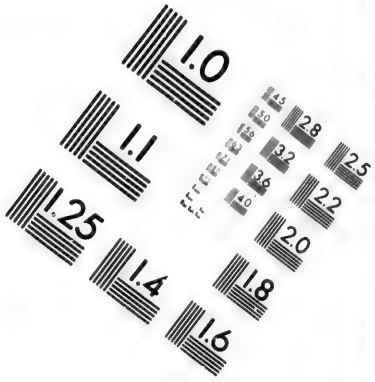
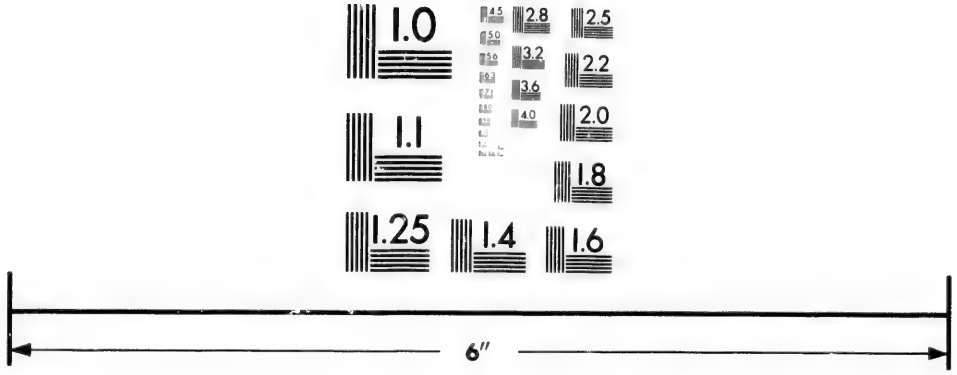
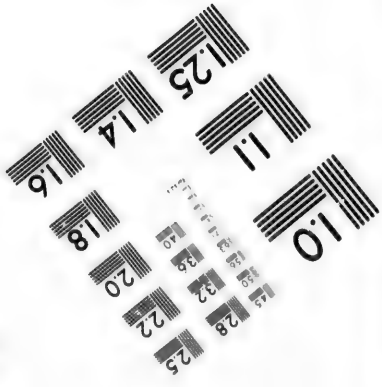


IMAGE EVALUATION TEST TARGET (MT-3)





Photographic Sciences Corporation

23 WEST MAIN STREET
WEBSTER, N.Y. 14580
(716) 872-4503

kind can be done only with good food, and a great deal of it. Therefore it would not pay to neglect this branch of the establishment—a niggardly logger would be deserted by his crew. In a well managed camp no liquor or beer is tolerated; its use might mean death to a man working in the open air with the thermometer at twenty degrees below zero. But the crew can have as much hot tea or coffee as anybody wants to drink.

No work is done on Sundays, and if the camp is near town some of the crew may go there. But most of them stay in camp, sleeping, "swapping stories," and playing cards. Wages are paid at the end of the season, when camp breaks up, and a man who worked steadily all winter draws quite a little sum of money in the spring. There is usually a few days' interval between breaking camp and the beginning of the "drive,"—the floating of the logs down the river. During this interval the villages and towns in the lumber regions do a lively business. The streets are full of men just back from the woods with plenty of money in their pockets and bound to have a good time. That their idea of a good time means principally drinking, gambling, and worse, might be expected. Of course, not all workmen in the lumber camps waste their earnings. Many of them are married men, often settlers who use the wages they earn to support their families until their clearings have grown into farms. Generally speaking, the notion, prevalent in many quarters, that the lumbering regions

are gathering-places of the "rough" element, is very erroneous. "Roughs" do not hanker after work of the character done in lumber camps. Crimes are rare in these sections, and those which occur are usually the result of bad whiskey.

As soon as the ice in the rivers breaks up, the business of sending the logs on their travels begins. Of all the operations required in the progress of the pine tree to the consumer, this is the one requiring the greatest hardiness in the workman. The river, to be sure, does the carrying of the logs, but the latter have a persistent habit of floating to the wrong places, getting stranded on sand-bars or snags, running into sloughs, and in various ways trying to escape from human control. Consequently it is necessary for a crew to follow the long-drawn procession of logs, or station themselves at the points known to be dangerous, and with their long-handled hooks to keep the obstinate ones in the main channel. In doing so it is often necessary to jump from one floating log to the other; and notwithstanding the sharp, stout spikes with which the boots are provided, to take an involuntary bath in the icy water is "just as easy as rolling off a log." The hardships and hazards of this occupation reach their climax when a "log jam" is formed, usually at one of the rapids with which most logging rivers abound. Then it becomes necessary, often at the immediate risk of life, to break the jam by removing some of the logs which by being stuck against the rocks hold

those above them in place. Many lives have been lost by the impetuous rush of the logs when those key-logs had begun to move.

Lumbering operations differ in various parts of the country, according to the topography, climate, and the species of wood lumbered. What has just been said of lumbering in the Great Lakes country is substantially applicable also to Maine and other northeastern lumber regions. Where hard wood is cut, transportation of logs by river is ordinarily out of the question, because these woods are too liable to sink and be lost. Some kinds of hard wood will not float at all. In the South, where the swamp-loving bald cypress (*Taxodium distichum*) is a very important timber tree, access to the places where it grows is sometimes gained by the dredging of canals, along which the logs are hauled to the mill. In the mountainous regions of the West, both the absence of heavy snowfalls in the woods and the immense size of the logs add to the difficulties caused by the topography. Here the logging railroad is of nearly universal necessity, supplemented by slides, on which the logs are sent to fly down steep mountain sides. Logging on the Pacific coast is even more interesting and picturesque to the spectator than that along the rivers of the Great Lakes country.

The business of bringing logs to the mill is not always done by the owner of the stumpage, or the mill, at his own risk. Often the job is let out to a contractor, who furnishes his own tools, teams,

men, and supplies, and is paid a stipulated price per thousand feet board measure. The measuring of the logs is a constant source of annoyance and frequent litigation. Rarely do the results of the scaler in the forest tally with those at the mill. The universal practice in the United States, is not to rely upon an actual measurement of the cubic contents of the log, but to compute the number of feet board measure; that is, the amount of boards of customary size that ought to be cut from each log. This is done according to one of a number of simple formulas known as Doyle's rule, Scribner's rule, and the like. These rules do not pretend to give accurate results, and the inherent deviations from the truth are increased by the size of the saw used, the skill of the sawyer, and other circumstances. The advantages over measurement by the cubic foot are that only one computation is necessary to get the amount of sawed lumber to be expected, and that the rule can be applied by any intelligent person, without even a rudimentary knowledge of mathematics. In several States official scalers are appointed, who receive their compensation by fees from the parties needing their services, and it is a rule of construction of logging contracts that in the absence of stipulations to the contrary the logs are to be scaled by these officers.

As we have seen above, the end of the lumber business, as now conducted, is in sight, although it is impossible to fix a definite date for its disappearance. But the service which it performs for

the national interests is too indispensable to let us believe that this disappearance will be more than a change of methods. To the art of utilizing timber will be added the art of producing timber. Hitherto, the influence which lumbering has exerted upon our forests has been a purely destructive one; the time has come when it must also become a protective force. But before we proceed to discuss the manner in which this great change may be brought about, we must devote a chapter to the ways in which the destruction and deterioration of forests has gone on since the influence of man was first felt by the primeval woods.

CHAPTER V

DESTRUCTION AND DETERIORATION

THAT the area of forest land within the boundaries of the United States is decreasing, there can be no doubt. It is unnecessary to bore the reader with columns of statistics on this point, even if accurate statistics were in existence; for it is quite unnecessary, in order to understand this phase of our subject, to know even approximately the number of acres of woodland annually converted into other forms of plant association.

However, for such an understanding it is necessary first to get rid of a number of vague and erroneous notions that are widely prevalent among people, even persons who ought to know better, such as lumbermen, economists, and leaders of public opinion. One of these mistaken notions is that there is danger of the forests disappearing all over the country, so that our grandchildren may be in the position in which it is alleged that the people of Spain, Greece, and other Mediterranean countries find themselves, where, according to popular view, wide regions have been converted into deserts by the ruthless destruction of forests. It is very likely true that there are districts in several portions of

the United States, where, on account of the reckless destruction of mountain forests, all those unfortunate consequences of excessive erosion, sanding up of valleys, excessive low water and floods in the rivers, and danger to the fertility of soils exist, which are probably more familiar to the general public than any other branch of the forestry problem. But for the country at large no such perils are threatening. For all regions that are not mountainous or in the immediate vicinity of mountain ranges, the question of over-erosion is of very little practical importance. This refers especially to the vast agricultural States of the Mississippi Valley and the Great Lakes country. By far the greater portion of this vast extent of territory is nearly level or rolling, and most of it is of such a nature that from an economic standpoint it would be a waste if much of the land were left to be forest-covered. Yet even here, notwithstanding the long and thorough settlement of much of this territory, the aggregate of woodland is still very considerable. Nearly every farmer has a more or less extensive wood-lot, for the purposes of fuel, fencing material, and pasturage of his cattle during the heat of summer. Whether these wood-lots are usually treated in the most profitable manner for their owners will be discussed in another chapter. Here we are only making the point that there is no probability of these regions being entirely deprived of forests.

Aside from the wood-lots of the farmers, there

are in many parts of the Lake and Mississippi region tracts of greater extent which are likely to be woodland for generations of men to come. These are sandy, broken, or swampy districts. There are in many even of the long-settled parts more or less extensive islands of this kind, where agriculture has made hardly any inroads on account of the infertility of the land. The swampy districts are perhaps the most hopeful of these tracts from an agricultural point of view; for they may be drained, or where that is impracticable, gradually dry up in the natural course of their development, and in either case they are apt at last to form very fertile meadows and fields. But there is no such prospect for the sand barrens and the "broken," hilly districts. The former are now, in the three great lumber States of the Lake region, as well as in the South, furnishing the greater part of the output of pine lumber. When that is removed, little of it is taken up by settlers, but most of the land is left to the forces of nature to do with it what they will. In nearly every case it still remains woodland, though of a very different kind from the original forest, and of little economic value. Large tracts of such lands, deprived of their original growth of merchantable timber by former lumbering operations, but still in an uncultivated state, can be seen in nearly every part of the country within the limits of the eastern forest zone.

There is also a very considerable amount of land being converted into forest which was formerly

devoid of tree growth. This will be a surprise to many people who hear only of the destruction of forests. I have in mind not only the planting of timber strips on the plains, which is rapidly redeeming the older settled portion of the region between the Mississippi and Rocky Mountains from the opprobrium of being treeless; I am also thinking of what is going on in the eastern prairie zone, and in the forest region proper. Since destructive prairie fires have become rare in Illinois, Southern Wisconsin, and other prairie States by the almost complete conversion of prairies into cultivated fields and pastures, the neighboring trees, both from the "openings" and the "heavy timber," have begun to occupy such prairie territory as the hand of man has not appropriated to himself. In many parts of these States there is actually to-day more forest land than there was twenty-five years ago, and as no lumbering on a large scale is carried on in these regions, the extension of the forest area is likely to continue for some time. Again, in the forests of Michigan, Wisconsin, and Minnesota, where open peat bogs are gradually drying, they are being covered by the spruce, tamarack, and arbor-vitæ of the neighborhood. The same process is reported from the bogs in Western New York, and is probably going on in many other localities. Finally a large acreage of woodland is being added each year by the natural reforestation of abandoned farms and "old fields" in the States of the Atlantic border and the South.

While, therefore, no grounds exist for the fear sometimes expressed that our posterity will know nothing of forests, nor the multitude of beautiful and ennobling influences radiating upon civilized men from woodland scenes and woodland life, still the fact exists that, taking the country as a whole, the disappearance of forests has reached that point where, in the interest of our national welfare, it should stop. And what is still more important, the character of our remaining forests is rapidly deteriorating in economic value. The place of old and valuable timber, capable of supporting our enormous lumber industries, is being taken by species of inferior value. White pine, the king of lumber trees, has almost gone, as far as its capacity is concerned to furnish the whole country with lumber and send a surplus to foreign parts. Black walnut, once exceedingly abundant in many sections of the country, some time ago became so rare and expensive that its use for furniture making has been largely abandoned. Hickory, on the use of which the world-wide fame of American "buggies" and other vehicles was based, threatens to follow the example of its cousin, the black walnut. Thousands of square miles that were once covered with tall and thick trees of great age, fit to be converted into the best kind of lumber, show to-day nothing but young growth of trees that will not be ripe for market in a great many years. Even that is the best and most desirable case. Far oftener the trees which have succeeded

the original forest are of different and inferior species. Where the comparatively valueless poplars and white birches or the despised jack pine have taken the place of white pine, there is a distinct loss of natural wealth. Still worse is the frequent case where, instead of young trees of vigorous growth, that in course of time promise a good crop of lumber, no matter of what species, scattered clumps of scrubby brushwood cover the land. All these conditions are found in the woodlands of the present, where the original forest has been cut; and unfortunately the first case seems to be the rarest.

As far as the eastern and much of the Pacific coast forest zones are concerned, it is self-evident that, under any circumstances whatsoever, the first necessity of civilized man in peopling this country was to get rid of the trees. In distinction from the prairie country and the Rocky Mountain forests, trees covered practically all the land. There would have been no room for men to dwell in, no room for cities and villages, no room for tilled fields, —in other words, no chance for civilized life,—if the settlers had not waged relentless war against the forest. This condition still exists in those regions east of the Mississippi where settlement is now going on,—as in Northern Michigan, Wisconsin, and Minnesota, as well as in parts of the South. Here the first necessity of the settlers still is to destroy the forest and to make farms in its place. This will continue to be the case as long as there are

forest covered lands valuable for agricultural purposes. No power on earth, under our form of government, can in the long run keep these lands out of the reach of the land-hungry settler. Nor is there any good reason why an attempt should be made to preserve forests of this kind, to a greater extent than the farmers themselves are doing by maintaining their wood-lots, provided there are areas of forests elsewhere sufficient to supply our national needs. Let it be remembered: Generally speaking, farming brings a larger profit from land than forestry, except on the poorer soil. Therefore, no good soils should be kept as forest, if poor lands are to be had for that purpose. For all who are interested in the promotion of a better forest policy on the part of our public authorities this point is of the greatest importance. They should never lose sight of it in their advocacy of measures and their attempts at enlightening the public. One of the commonest objections to laws for the protection of the forests in newly settled regions is the plea that it would retard the development of the country. It would keep away settlers. People living in the older parts of the country can form no idea of the importance which the residents of new districts attach to the coming of new settlers. A hundred new families taking up land in a county every year is the condition which makes every business man in the county towns prosperous. If immigration stops, bankruptcy is at the door. No wonder, therefore, that people in such localities, people of

intelligence and weight in the community, are afraid of anything which seems to interfere with the course of settlement. Therefore the point that agricultural lands are not wanted for forestry must ever be emphasized and repeated.

To return to the question of forest disappearance, from what has already been said it must be clear that such destruction of forests as is detrimental to the interests of the nation cannot be laid at the door of the settler, at least so far as his clearing of wild lands for legitimate purposes is concerned. Must it then be charged to the lumberman?

At first blush an unqualified "Yes" seems to be the proper answer to this question. The methods of lumbering in this country have been from the beginning of a rough-and-ready sort. Lumbermen have been intent to convert the timber standing on their holdings into cash in the shortest possible time and have cared little what became of the land after they had removed such timber as they could find a profitable market for. If these lands could be sold, they have sold them for what they would bring. If no purchasers were on hand, they have abandoned them, not caring even to pay the taxes. Where lumbering consisted of culling a few trees of marketable species from among the mass of others, it has affected the original condition of the forest comparatively little. Where, on the other hand, lumbering meant cutting practically every tree on the land, as in these latter years has been done in the pineries of the Northwest, a

revolution in the condition of the land has been wrought which offers to the forester and the legislator perhaps the most difficult forestry problem anywhere in the world. Rarely did the lumberman bother himself about the future supply of timber, or its reproduction. The most he did was, in the early days when small logs were not salable, to leave uncut trees of less than twelve inches. To-day he goes over the same lands and takes what he left thirty years ago, this time down to the "pole" of eight inches and less in diameter. This is what is misnamed second-growth timber in many parts of Maine and the Northwest.

These methods were rough, no doubt, and apparently irrational. Yet there was an excuse for it. Lumbermen did not do business for the benefit of posterity or for the general good. Their only object was to reap the largest possible profit in the shortest possible time. They were in the same condition of mind with practically the whole people when they gave no thought to managing their forest property in such a way as to provide for a reproduction of their crop. That the whole people were regardless of such provision is shown by the fact that in all legislation touching the public lands, their disposal and protection, the maintenance of the forests growing thereon was, until within a very few years, absolutely lost sight of.

It is, then, the lumbermen no more than the settlers who must bear the chief blame for the deterioration and unnecessary destruction of American

forests. The greatest burden of guilt rests on our public authorities, which is only another way of saying that it lies upon all the people of the United States. The question of the relation of the legislative and executive authorities of the country to the forestry problem is treated in another chapter. But here is the place to show how, through the almost utter neglect of its duty to take proper police measures, the people of the United States has given unchecked opportunities for the work of the worst enemy of our forests, an enemy that has caused a great part of the undesirable decrease of area and nine tenths of the deterioration in value of the area still covered with woodland.

Nearly every reader must have guessed by this time that the enemy here referred to is the fire. For, unfortunately, the American public is very familiar with forest fires. Not a year elapses when tales of disaster from this source in one part or another of the country do not fill the columns of newspapers. If this familiarity has not bred contempt, it has at least caused a prevalent belief that forest fires are inevitable events, incidental to the existence of forests, and to be submitted to as visitations of Providence against which one can guard no more than against tornadoes and earthquakes.

Yet this belief is utterly wrong. No proposition in connection with American forestry is better established than that forest fires, practically without exception, are the result of human agency. It is sometimes said that lightning causes forest fires.

This may be possible, but as far as I know no case of such origin has ever been actually observed and recorded. One popular writer repeats after the other the story that forest fires have been caused by two dry branches being rubbed against each other by the wind. No experienced woodsman or forester will believe in such a tale. It belongs in the same category as the two-headed snake and the hybrid between the rabbit and the lizard.

Fires are kindled in the woods constantly for perfectly legitimate purposes. Settlers are obliged to get rid of the debris in clearing by burning it; cruisers, hunters, and other travellers build camp-fires. Both these uses of fire cannot be avoided. In some parts of the country, especially towards the South, where the tree growth is very heavy, the underbrush is fired for the purpose of killing the trees, to make clearing more easy. This is a bad practice, for several reasons, and should be discouraged as much as possible. Still less to be commended is the custom indulged in throughout much of the Alleghany Mountain country, in the far West, and possibly elsewhere, of firing the dry covering of the forest floor every spring, in order to produce young shoots from the stumps, promote the growth of herbage, and uncover the acorn and chestnut mast littering the ground. All this, of course, is done for the benefit of browsing cattle, and especially that pest of southern woodlands, the razor-back hog. Pasturing cattle in forests is rarely an economical practice, but where it is favored by

systematic firing of the woods it cannot be considered but evidence of low standards of civilization on the part of a population that allows it.

Where fires are kindled for legitimate purposes, where due precautions are taken in doing so, a careful watch kept over them, and, in the case of campfires, where they are put out before campers leave the place, there is no need of their doing any injury. But, unfortunately, such careful treatment is not very frequent. One would imagine that the settlers, who are going to be the greatest sufferers if the flames get beyond control, would be those most careful in their handling of fire. The contrary is true. This is a sad commentary on human intelligence, but no doubt can exist of the fact. The settlers themselves are very apt to deny that fires are largely caused by their own negligence. They lay the blame on almost anybody else. Sometimes it is the railroads against whom the charge is made; then again the hunters and fishermen from the city; where Indians are present they get most of the blame, and the hated tramp never escapes condemnation. As a matter of fact, the railways used to be very careless about how sparks from their locomotives set fire to brush heaps along the road. But stringent laws were passed in many States requiring them to keep their rights of way clear of debris; heavy judgments for damages caused by their negligence were repeatedly awarded against them, and the railways have learned the lesson. No doubt it is still very common for fires to start

along the tracks, not in forests only, but on the prairies and among cultivated fields. But they are extinguished almost immediately by the section crews, or even by the train hands themselves. It is very doubtful whether many destructive fires during recent years have been caused by passing trains. As to the city sportsmen, they are mostly persons of not a little intelligence; they have heard a good deal about forest fires, and are rather inclined to be cautious. Moreover, they are usually accompanied by experienced woodsmen and guides, who see to it that fires are properly handled. As to the Indian, no doubt little good can be expected of most of his race; still I doubt whether he is, on the whole, more reckless than the white settler. The tramp, to be sure, may fairly be charged with all iniquity, for he stands convicted of almost every crime; but, on the whole, his kind is not very common in most of the forest regions. So the attempt of the settler to shift the burden on other shoulders must fail, and the fact stands out clearly that his own negligence is the most frequent cause of the conflagration of which he is apt to be the first victim.

If the settlers are apt to be reckless in their manner of kindling and guarding fires, they are still more negligent in the matter of extinguishing fires that have arisen in one way or the other and are no longer being used. Nothing is a more common sight almost anywhere within the larger forests of the United States than to see small fires smoulder-

ing along the roadsides or trails. Yet hardly ever does a passer-by take the trouble of putting them out. This would seem to argue a strange moral defect on the part of the inhabitants of these regions. Would any decent man hesitate to put out a fire he saw approaching a powder-mill? Yet a little thought will convince us that the moral callousness of the passers-by is only apparent. They are merely following the prudent rule of minding their own business. Fires kindled in the woods, intentionally and legitimately, are so common that you cannot tell but what the roadside blaze may belong to this class. Its originator may be in the immediate vicinity and reappear the next minute to watch the flames. In such a case would not the officious stranger who put them out be like the man who forcibly kept a bather from going into the water, in the belief that he was saving an unfortunate fellow-man from suicide?

Most fires, even if left entirely to themselves, go out after a while of their own accord, without having spread over more than a few feet of ground, or having done appreciable damage. Green vegetation is not a good food for flames, and is rarely consumed except by fires of very great dimensions and consequently enormous heat. In places where there is no large accumulation of dry, dead material the danger is consequently insignificant. It is but a small part of the fires that ever spread at all, and even those which assume large proportions soon come to a stop. The great disasters so often

recurring are not usually the work of a single fire, but of numerous small fires burning throughout the district.

Ordinarily, during a dry season, there are many small fires burning in all the forest regions of the country, but especially where lumbering is actively carried on, or where clearing for settlement is rapidly progressing. This is particularly true of the coniferous forests, while broad-leaved woods are comparatively exempt from fire.

The odor of smouldering pine wood is one of the most familiar sense impressions one experiences in such districts. Its pungency is very characteristic of the pineries, and never to be forgotten by one who has once noticed it. These low smouldering fires show very little flame. In the daytime, at least, there seems to be nothing but smoke, a dense, blue or grayish cloud rising towards heaven and gradually taking a paler hue as it disperses in the air. At night, one sees the fire itself gleaming afar, close to the ground, without tongues of flame breaking forth, but rather looking like a pile of glowing coals. Very often the fire is located in a stump of pine, or in a fallen log. In these cases it rarely spreads to the surroundings. The grass and litter for a foot or so surrounding the seat of the fire is quickly consumed, marking a charred, black circle. But thereafter this zone of charred litter acts as a confining band, across which, under ordinary conditions, the fire cannot spread to attack the vegetation beyond. Thus the stump or log is

slowly converted into charcoal. The smouldering may go on for days or weeks; if rain comes, the fire is quickly extinguished. Otherwise it burns on till the whole is consumed.

This is the ordinary progress of a neglected fire of this kind. But far otherwise is its history when, during a long drought, a wind fans the smouldering fires into active, leaping flames. During those long, oppressive summer days, when day after day the relentless sun beats down, even the dense shade of the broad-leaved trees no longer suffices to keep the forest floor damp and cool. In the pine woods, the heat becomes stifling. The litter of needles on the ground becomes as dry as sand. The cushions of moss lose their softness and turn brittle, so that you can rub them to powder between your fingers. On the open slashings the soil dries up and the litter of dry branches, tree tops, and other debris left by the lumbermen during the preceding winter becomes so dry that the first spark must set the whole ablaze. Small fires multiply everywhere, for every day new ones start, and there is no rain to put out the old ones. The smoke begins to fill the atmosphere, and there is a dark grayish haze over all distant prospects, quite indescribable and entirely different from the silvery haze caused by light mists, or the ordinary blue produced by the mere distance. The pungent smoky odor penetrates everywhere. In the villages and towns it enters houses, causing the women to look with dismay at the lace curtains before the windows.

As yet there is no danger. Here and there, fanned by light winds, the fire begins to run along the ground, eating up the litter, grass, and herbage, coloring the lower portions of the tree trunks black, and destroying the humus, sometimes to a great depth. These small fires seldom spread over more than a few acres. They really do untold damage, more, perhaps, in the aggregate than the great blazes destroying live trees. For, especially if they recur year after year in the same place, they prevent the propagation of trees by killing the seeds or seedlings. They also render the soil infertile by destroying the organic matter contained in it. But to the settler this kind of fire seems hardly worth mentioning. If the blaze comes too near his fences, he attempts to put it out or check its spread. If it is burning far away, on the pine slashings, he lets it burn.

Still, as the days go by and the smoke becomes denser and denser, as at night the villages seem to be surrounded by the camp-fires of hostile armies on all the neighboring hills, the people of the towns begin to be anxious about what may be coming. The railway crews, as they come in on each train, begin to tell about fires along the line. Then "homesteaders," whose log cabins are in the most remote fastnesses of the wilderness, come into town with tales of distress. The fire has reached their clearing; without the aid of neighbors, who may be miles away, anxious about their own safety, the homesteader, with his wife and older children, has

made a hard fight for his property. But in vain; his cabin, with what little furniture he possessed, with the family clothing and the provisions that were to keep them alive, have been consumed by the fire. With his little children on his arm, followed by the older boys and the wife carrying the baby, he trudges along the trail through the hot, stifling, smoke-filled wood to the village. The people of the town relieve the distress of their stricken fellows and go to bed thanking God that still they are safe.

But there comes an evening when nobody thinks of going to bed. All day the smoke has become denser and denser, until it is no longer a haze, but a thick, yellowish mass of vapor, carrying large particles of sooty cinders, filling one's eyes and nostrils with biting dust, making breathing oppressive. There is no escape from it. Closing windows and doors does not bar it out of the houses; it seems as if it could penetrate solid walls. Everything it touches feels rough, as if covered with fine ashes. The heat is horrible, although no ray of sunshine penetrates the heavy pall of smoke.

In the distance a rumbling, rushing sound is heard. It is the fire roaring in the tree tops on the hillsides, several miles from town. This is no longer a number of small fires, slowly smouldering away to eat up a fallen log; nor little, dancing flames, running along the dry litter on the ground, trying to creep up the bark of a tree, where the lichens are thick and dry, but presently falling back

exhausted. The wind has risen, fanning the flames on all sides, till they leap higher and higher, reaching the lower branches of the standing timber, enveloping the mighty boles of cork pine in a sheet of flame, seizing the tall poles of young trees and converting them into blazing beacons that herald the approach of destruction. Fiercer and fiercer blows the wind, generated by the fire itself as it sends currents of heated air rushing upward into infinity. Louder and louder the cracking of the branches as the flames seize one after the other, leaping from crown to crown, rising high above the tree tops in whirling wreaths of fire, and belching forth clouds of smoke hundreds of feet still higher. As the heated air rises more and more, rushing along with a sound like that of a thousand foaming mountain torrents, burning brands are carried along, whirling on across the firmament like evil spirits of destruction, bearing the fire miles away from its origin, then falling among the dry brush-heaps of windfall or slashing, and starting another fire to burn as fiercely as the first.

In the village there is a suppressed excitement. Little is said by anybody. Every man and woman is busy preparing for the worst. The sawmill has shut down, and the hands are busy refilling the water barrels on the roof; the merchants put barrels of water in front of their stores, and get pails handy. In the dwelling-houses similar preparations are made. Women pack their clothes and valuables into trunks and boxes. The captain and

members of the volunteer fire brigade get their apparatus into readiness, although they doubt whether it will be of much effect if the flames reach the town.

Down at the railway depot the telegraph operator sits at his instrument, "talking" to the people "down the line," in the happy places far from forest fires. He tells them that fires are surrounding the village on all sides; there is danger of the town being reached to-night. Several small blazes, caused by flying brands, have already occurred but been quickly put out. Many of the settlers in the surrounding country have come into the town, after having lost all their goods. There is a rumor that several persons have perished, but as yet it is unconfirmed. Suddenly the clicking of the receiver ceases—the connection has been interrupted, undoubtedly by the fire. Still he can telegraph by the other end of the line—until that also ceases. Now the village is cut off from all the world, except, thank heaven, for the night train. If that goes through safely, and the fire has reached us by that time, a relief train can be up here by to-morrow noon.

As night comes, the flames in the distance become more visible, and now it is seen that there are fires on each side of the city. The fire on the west threatens the greatest danger, for from that direction the wind is blowing. On the east side the road to the lake, two miles away, is open. There is hard wood in that direction, until you get

to the tamarack swamp along the shore. A boy has been down there and reports that there is some fire in the swamp, but otherwise the road is clear. Horses are being hitched up, wagons loaded with household stuff, everything brought into readiness to take flight to the comparative safety of the hardwood tract. If that also should succumb to the fire, then there will be no safety except in the lake. From the west, the wind brings the fire nearer and nearer. It does not travel fast like the sweep of a prairie fire. There is something horrible in the slow, steady approach of a top fire. It comes on with the pitiless determination of unavoidable destiny, not faster, perhaps, than a man can walk. But there is no stopping it. You can fight a ground fire, by trying to beat it out with brush, or throwing earth upon it. You cannot fight a fire that seizes tree top after tree top, far above your reach, and showers down upon the pygmy mortals that attempt to oppose it an avalanche of burning branches, driving them away to escape the torture and death that threatens them.

By midnight the fire has reached the village. The first houses, standing as they do in the midst of forest trees on their lots that were partially cleared but a few months ago, are quickly consumed. Each man in the village is straining every nerve to protect the houses which at each particular moment are most in immediate danger. But all is without avail. Building after building is rapidly turned into a smoking pile of ashes. The heat, the smoke,

the excessive labor are beginning to exhaust the workers. There is one hope left. The little river and the vacant places on both sides of it may check the advance of the fire. Vain hope! Firebrands soon carry the destruction to the other side, and the very ground in the open spaces carries the fire along, for it is mostly sawdust and other refuse of the lumber-mill. Now there is nothing left but retreat. When the morning breaks, the people of the village and the many families of settlers who came in from the woods the preceding day find themselves huddled together in the adjoining hardwood tract, which happily opposes an effective barrier to the progress of the flames.

But not all are there. Many have perished in the flames or been smothered to death by the smoke. What need of dwelling on the harassing scenes accompanying such disasters? The next day the relief trains come and the hearts of the American people—which is more ready to try by lavish outlay to heal wounds after they are made than to prevent them by wise forethought—open to the sufferers and relieve their necessities.

Such descriptions as these are no pictures of fancy. Not a year passes when forest fires do not cause losses of life and destroy the habitations of industrious settlers. From time to time horrible calamities, with enormous losses of life, occur, and send a thrill of horror throughout the civilized world. Of such calamities, the worst that is on record is that known as the Peshtigo fire, which,

in 1871, during the same month of October when Chicago was laid in ashes, devastated the country about the shores of Green Bay, in Wisconsin. More than three million dollars' worth of property was burnt, at least two thousand families of settlers were made homeless, villages were destroyed, and over a thousand lives lost. The next greatest forest fire was that of 1881, in the Saginaw region of Michigan. After having burned here and there in the usual manner for weeks, it became uncontrollable on September 5th, when many of the separate blazes united into one immense sea of flame that swept resistlessly over the counties of Huron and Sanilac, as well as portions of adjoining counties. About eighteen hundred square miles were involved in ruin, and in a large portion of this territory the flames made a clean sweep of trees, as well as crops, fences, houses, bridges, and everything of an inflammable nature, turning the land temporarily into a desert. The total loss in property, aside from standing timber and injury to the soil, was estimated at over two millions of dollars. One hundred and thirty-eight persons, many of them women and children, perished in the flames. The relief sent to the sufferers by the people of the entire country, in addition to large quantities of supplies, amounted to $1,006,102.47.

In regard to the loss of life, few forest fires have been more appalling than that which, in 1894, devastated the country southwest of Duluth, Minn., and is usually known as the Hinckley fire. Over

400 persons were killed in the holocaust, 233 of them in the village of Hinckley alone. At the same time the flourishing city of Phillips, in Wisconsin, was also destroyed, and numerous persons perished, while many others were saved only by plunging into the waters of the little lake on the banks of which the city stands.

With the happy buoyancy characteristic of the American people, and so quickly caught by the immigrants from foreign lands, the inhabitants of the regions where forest fires are of common occurrence have been quick to discover that the fires are not an unmixed evil. It is said that they help to clear the land and make it easier for settlers to establish their farms. In a sense, this is true, and it might be added also that settlers, if they happen to burn out during the first few years after they have taken up their land, often find themselves better off than before as soon as the inconvenience of the first houseless days is over. They are quickly provided with new clothing, furniture, supplies, and other necessaries; their log cabins are quickly rebuilt, without cost to themselves; not rarely seed corn and potatoes are provided by appropriation out of the public treasury, and a year after the fire the stricken settler is again on the road to prosperity. While this hopefulness and moral elasticity is of the greatest advantage to the welfare of the people in the forest regions, it unfortunately also has a tendency to keep them from really appreciating the seriousness of the injury done by fire to our national

wealth. The lumbermen appreciate this seriousness, for they derive none of the incidental benefits from the fires. But as a rule the settlers do not. Nothing is more frequently heard than the expression that forest fires are really at the bottom a good thing. Naturally, this state of mind makes it difficult to convince the voters of the desirability of taking steps for the prevention and extinction of fires, and especially of incurring the unavoidable expense connected therewith.

Another frequent view of the question on the part of settlers is that there is but one way to get rid of fires, and that is to get rid of the forest. Both this and the preceding opinion are, of course, utterly selfish, narrow, and short-sighted. But most people, from ignorance and moral obliquity, see only those sides of the question which immediately touch them in their own personal affairs. Consequently, these opinions among the people are hard to combat, and they constitute one of the most serious obstacles to the passage of proper fire-police laws.

As far as the injury done by forest fires to farm and village property is concerned, this subject is really but indirectly connected with forestry. The modifications undergone by the methods of lumbering on account of the prevalence of fire, and the measures calculated to guard against destruction by fires, are treated in other chapters of this book. Here is the place to speak of the injury done to the value and condition of the growing forests. In this connection it should be stated that a systematic

study of this question has never yet been made. Scattered observations are found throughout the voluminous forestry literature of the country, but much remains to be learned by actual detailed study in the field.

It has already been stated that the origin of practically every forest fire is by the negligence of human beings. Such negligence, however, would find nothing to act upon if it were not for the enormous quantity of dry, inflammable litter which accumulates in the uncared-for forests of our country. Enormous brush heaps, consisting of the tops and branches of felled trees, are left by the lumbermen lying on the ground to dry; every windfall causes an even worse tangle of drying sticks; in many forms of vegetation a large amount of thin, dry twigs accumulates on the ground as the trees gradually clear themselves of their lower branches. In the Lake region tamarack and cedar swamps are one of the most prolific sources of fires. Many of these swamps are rapidly drying in the natural course of their life-history. In fact, many tamarack thickets in that section no longer deserve the name swamp. The cushions of sphagnum and other mosses, which in these swamps often reach a thickness of several feet, become dry every summer, and in this condition are as easily set afire as a pile of loose cotton. The Phillips fire started in a drying tamarack swamp just west of the city.

As a general rule, fires do little harm to hardwood forests, although occasionally the flames

from adjoining coniferous areas spread and destroy the broad-leaved trees. In all parts of the country, coniferous trees, the pines and spruces and their kin, are most liable to fire. One must not imagine that a single fire often destroys large quantities of large, vigorous timber. Top fires,—that is, fires which reach the crowns of trees, spread from branch to branch, and consume the whole tree, leaving at most a charred, dead remnant of the trunk standing upright like a blackened ruin until the wind overthrows it,—are the exception. The ordinary fire is a surface fire, eating up the litter on the ground, the feebler undergrowth, and the young trees, and only scorching more or less severely the large timber. If a fire of this nature is very hot it may even kill the large trees, without, however, consuming them. In such a case, much of the timber can be saved if it is cut at once, before fungi and insects have destroyed the wood. Fires of this kind do their greatest harm by making it impossible for trees to reproduce themselves, because the young trees are killed or even the seeds destroyed in the ground. It is remarkable, by the way, how much heat some tree seeds can stand. The cones of the jack pine (*Pinus divaricata*, Ait.), for instance, remain on the trees sometimes for several years without shedding their seeds. When a fire burns over the ground, the heat causes the cones to open, and the seeds fall on the hot ground. Yet these scorched seeds often survive and bring forth seedlings.

The injury to seedlings and young trees is even greater in places where the old trees have been removed than it is under the growing timber. In the latter places, reproduction is often prevented or hindered by other causes, even if no fire intervenes. But on all detimbered areas there should naturally come up a new forest growth, either of the original or different species. These cut-over tracts, however, are the very ones where fires are most common. During the first dry season, often in the very spring after the timber has been cut, the debris left by the lumbermen is burned. Thereafter, for a number of years, the danger of fire annually running over the tract is very great. The soil is very quickly covered with rank grass and herbage, which in the fall dries up and becomes very inflammable. Few seedling trees, coming up amid this tangle, remain alive after even one such scorching. After the trees have passed the seedling stage, still the danger is not over. For although the young trees coming up may be largely of broad-leaved varieties, what was said of the comparative immunity of hard woods refers to old timber and not to young trees. While the latter remain in the sapling stage, they are liable to have their foliage destroyed, even if the stems escape serious injury. It stands to reason that such loss of foliage interferes with the healthy growth of the tree, and, if often repeated, must kill it. In any event, there is danger of the trees remaining valueless runts instead of producing tall, clean timber.

After a fire has killed brushwood or a body of standing timber the scene is one of dreary desolation. The ground is thickly covered with gray ashes or black cinders. Charred branches and trunks, some of the latter still standing erect, others strewing the ground in wild confusion, is all that remains of the once green forest. But nature does not long leave her nakedness uncovered. Grasses and herbs of various kinds at once begin to sprout, and it is a curious fact that few of the varieties appearing on the burnt-over places are identical with those growing on the floor of the forest while it was still standing. The species which appear on such burnt areas differ, of course, very much according to the part of the country and the nature of the locality. One would not expect the same vegetation to cover the slashings in Maine, in North Carolina, in Wisconsin, and on the Pacific coast. But everywhere there are some characteristic plants that mark the place where the fire has been, and these plants have often been popularly distinguished as fire-weeds. One of the most widely spread is a tall plant with showy, purple flowers, called *Epilobium angustifolium* by the scientists. When it is in blossom it imparts a great splendor of color to the tracts it covers in large masses. The little red cherry shrub known as *Prunus pennsylvanica* is called fire cherry in Wisconsin, and probably elsewhere, because it is always found on burnt tracts. Blackberries and raspberries are apt to follow the fire. In the meantime,

while these smaller plants are vigorously spreading, the seedlings of trees are struggling upward beneath the tangled mass, sometimes protected by their shade, at other times hindered by their rank growth. After a while they are sure to win, and as they raise their tops over the weeds, they in turn begin to shade the ground, and the first comers gradually die off because they no longer get sufficient sunlight. Now, if the fires keep off, there is no reason why in the course of time a new forest should not grow up, with trees as tall and vigorous as in the old one. But, unfortunately, in most parts of the country the fire does not keep off. During all the younger stages of the new growth the soil remains covered with much inflammable material, and oft-repeated scorchings prevent the trees from ever becoming tall and healthy. In this way, what was originally fine forest, producing valuable merchantable timber, is in many cases succeeded by a wilderness of shrubs and stunted trees, hardly good enough to furnish fire-wood.

Recapitulating what has been stated regarding the influence of fire upon the extent and value of American forests, it may be said: Fire reduces the extent of forest area by destroying growing timber; it prevents reproduction of forest by deteriorating the soil, killing seeds and consuming seedlings; and it deteriorates the value of existing woodlands by hindering the vigorous and healthy development of trees. Which of these three forms of injury is most prominent depends on the section of country,

the topography, the character of the forest, and many other conditions. A detailed study of these considerations would far exceed the limitations of this volume.

Another factor in the struggle for life of the American forests has hardly yet been mentioned. That is the injury done by the pasturing of domestic animals. This source of injury is neither so wide-spread nor so picturesque as the damage done by fire. Yet in some localities it is an equally great obstacle to profitable forest cultivation. In the Lake region it is of comparatively small importance, for the reason that the tracts where the farm cattle go are usually among those which will soon be cleared and converted into fields. But in the mountain forests of the Rockies and the Pacific coast, where immense herds of cattle and sheep are pastured, the injury done to the small trees by the biting off of young shoots, the tearing down of branches, and the trampling down of seedlings is enormous. In the great forest reserves recently set apart in that section by the federal government, the herding of animals is now permitted only under strict rules designed to reduce the damage to a minimum, to the great disgust, however, of the cattle owners, who, like other people, can see but their own interests and cannot be convinced that other people, and especially the nation as a whole, have rights in the matter. In the Alleghany region, and especially those portions which are thinly settled by a poor and ignorant class of farmers, but

where agricultural development is not likely to continue, much damage is done by cattle, and especially by hogs, which tear up the ground and destroy seedlings and tree roots. The abominable practice of annual firing of the undergrowth, so prevalent in this section, has already been mentioned. In the miniature forestry operations of the farm timber-lot throughout the great agricultural States east of the Mississippi the pasturing of cattle also plays its vicious part and is one of the causes of the deterioration which so many of these small forests are undergoing.

From all the facts which have been briefly considered in this chapter the following main conclusions may be drawn. Taking the North American continent as a whole, the decrease of area covered with forest growth, while considerable, is not such as to warrant alarm. But, on the other hand, in almost every part of the country existing forests are rapidly deteriorating in value as sources of wealth and foundations for the numerous industries dependent on forest products as their raw material. These conclusions should be firmly held in mind for a proper understanding of the forestry problem.

CHAPTER VI

FORESTS AND FORESTRY

IN the preceding chapters of this book we have attempted, in a necessarily faint outline, to describe the character of the American forest in the various sections of our continent; the part it plays in the economic and social life of the nation; its history, as determined by the forces of nature and modified by the activity of man. The last-named feature forms a natural transition to the second part of the subject-matter of this volume, American forestry.

To the great mass of the American public the word forestry conveys but an indistinct meaning. Not rarely it is said that forestry is something new in this country. Nothing could be farther from the truth. It is the word that is comparatively new, but the thing itself is as old as human life on this continent. With the same truth could it be said that agriculture is something new in this country because agricultural colleges and experiment stations are but a generation old, as to say that forestry is new because only within the last few years has it been systematically and scientifically treated in the United States.

For let it be understood as clearly as the English language can express it: Forestry is not, as many imagine, the science or natural history of woodlands; nor is it the art of planting trees; nor that of preserving woodlands. It embraces all these things, or at least special phases of them are required in its practice. But it is made up of many things besides. Nor should it be forgotten that forestry as such is not a matter for poets, artists, or sentimentalists, nor even for lovers of sport with rod and gun. There is no reason why the forester should not be a lover of the beauty of woodland scenery. Very often he is, but not by virtue of his being a forester, but because he is a man of wide and liberal culture and with strong esthetic sensibilities.

If forestry is not all this, what under the sun is it, the impatient reader will be ready to cry. It is simply the art of managing forests and utilizing them for the benefit of their owners. As soon as a human being begins to take for his use the manifold natural sources of wealth contained in the primeval woods, he practises the art of forestry. The mountain farmer who uses the uncleared portion of his land as a pasture for his lean cows and a rooting ground for his razor-back hogs, is practising a rude sort of forestry; the lumber king who sends out his crews to fell the white pine and convert it into boards and beams, is a forester on a large scale; the turpentine manufacturer of North Carolina, the maple-sugar boiler

of Vermont, both are engaged in forestry. Even the rich man who fences off a tract of woodland for a game preserve is a forester. In no country of the world has forestry in one form or another played so important a part as in the United States and Canada.

If forestry is nothing more than that, then why all this hue and cry, this agitation by word and pen, this petitioning of legislatures and spending of money which has been going on all over the country for the last twenty years or more? The answer is that forestry in this country need not be introduced, but its methods must be reformed. In the rapid changes of conditions which the development of our country has brought about, prevailing methods of forestry have become antiquated. What was once the most advantageous way of utilizing woodlands has become wasteful and in the end ruinous to us as a nation, and often to the individual land-owner. Therefore the persons who have realized these changed conditions are anxious to disseminate among the people a better knowledge of the facts and principles concerning the best treatment of forest property, and wherever necessary to cause the passage of laws designed to further this end.

If forestry is nothing more than the utilization of forests, it necessarily follows that improved methods cannot be inimical to the interests of forest owners. That is the best method of forestry which is to the greatest advantage of the

proprietor of the wood. Almost self-evident as this appears, the contrary opinion was formerly very common among timber-land holders, lumbermen and others. It still lingers here and there. To some extent the promoters of reform have themselves been at fault for this odd circumstance; for they have sometimes laid such exclusive stress on the *preservation* of forests that outsiders could easily be led to think that they wanted all lumbering operations to stop.

Such a misunderstanding cannot last long in an intelligent community, and is rapidly disappearing from the public mind. In its place another delusion sometimes takes hold of well meaning people. That is an idea that what is needed consists in a transplantation to this country of the forestry system flourishing in some foreign countries, and particularly in Germany. Such a step, if it were possible, would be foolish. Conditions in this and European countries differ so much that what is practicable in one country is often out of the question in another. What we can learn from Germany and other countries with highly developed forestry is, not their methods and systems, but the principles on which they are based, for those principles are determined by the universal laws of nature and human society.

It being understood that forestry is the art of utilizing forests for the advantage of their owners, we will make a great step towards a clear comprehension of the subject by considering what that

advantage may be. I now have in mind the case of private ownership, for where forest lands are owned by the public, certain considerations come into play which must modify the conclusions. Clearly a man may have a diversity of objects in view when he becomes the owner of woodland. The most numerous class of forest owners in this country are farmers who keep a portion of their homestead under timber. Forests of this kind are rarely over a hundred acres in extent, and usually much smaller. Their obvious use is supplementary to agriculture. They supply fire-wood and fencing material, pasturage to the farm cattle; occasionally some logs are sold to produce an incidental cash revenue. In such cases the dominant principle of treatment should be to maintain the forest permanently in as good condition as possible for the use it is put to, with as little outlay of money and labor as will accomplish that end. Ordinarily it would not pay to manage it with a view to large or continuous pecuniary returns.

On the other hand, a person may own large tracts of timber-land from which he may desire a revenue. The land represents a large amount of invested capital, and good business principles demand that the investment should yield a reasonable interest. In such cases a variety of different systems of treatment would be indicated, according to the circumstances of each case. If the proprietor finds that his capital will be most productive if he takes from the land the greatest possible amount of timber

growing on it, markets it as quickly as he can, and then disposes of the land, so that he may buy new tracts to repeat the same operation, or put his money into some other business, then this will be the best method of forestry in that particular case. If, on the other hand, the owner thinks that, for any reason whatsoever, he will be best off if he conduct lumbering in such a way that he can cut successive crops of timber from the same land, then he would be a poor business man if he did not adopt forestry methods calculated to accomplish that end. The former of these conditions is the one in which most lumbermen in this country find themselves at present. As long as the value of the land, aside from that of the merchantable timber growing on it, is very low, and as long as plenty of original timber is still in the market, waiting to be cut, a lumberman who would attempt to incur the additional expense of shaping his cutting with a view towards the best manner of timber reproduction would be unable to compete with other lumbermen who do not care for the permanency of their industry. It follows that, generally speaking, the lumbermen are not the reckless destroyers of forests they are often considered, but are merely doing what the nature of their business compels them to do; and they will continue to do so until the conditions have changed, either by the action of economic laws, or by the effect of governmental action.

Supposing that in any given case it is economical to treat a timber tract so as to insure its perma-

nence as a lumber producer, the owner may still have different objects in view. He may wish to derive a regular, annual revenue from his forest; or he may be satisfied to obtain pecuniary returns only at more or less distant intervals of time. Again, he may insist on having a net profit upon the value of the invested capital, calculating the same by including the value of the land at each given period; or he may be satisfied with a like profit on the actual cash outlay, without considering for the purpose the increased value of the land, or unearned increment, as the political economists call it. All these different objects, together with numerous other considerations, must modify the manner in which a skilful forester would treat any given piece of woodland. In every such case, however, the management proceeds in such a way as to obtain the largest possible cash revenue without impairing the ability of the land in the course of time to produce another installment of income. In other words, instead of considering the timber a crop to be reaped but once, the land is expected to furnish crop after crop, at due intervals, just as a skilful farmer expects to repeat the operation of planting and harvesting indefinitely on the identical piece of land.

There are still other purposes for which forest lands may be held by private parties. Here and there one finds a man who has planted a tract of land with trees of a particularly valuable kind, such as black walnut, to be cut and harvested by his children,

or in his old age. Forest operations of this kind are advantageous even if the final harvest does not produce a net profit upon the outlay with compound interest during the period of growth. They are considered in the light of making a sure provision for the future, reasonably free from the vicissitudes of business affairs, very much in the nature of life insurance. On the formerly treeless plains between the Mississippi and the Rocky Mountains, a large aggregate area has within twenty years been planted with trees in small strips. In this case the question of pecuniary profit from these small forests has not usually been taken into consideration, but the owners derive other advantages of various kinds. The timber strips protect the farms against injurious winds; they afford shade for man and beast; and are in many other ways a benefit to the inhabitants of these monotonous regions. In many of the mountainous districts of the East, and to a less extent elsewhere, considerable tracts of forest have of late years been acquired by individuals or clubs, and are maintained as game preserves and pleasure resorts. The question of revenue from lumbering, or otherwise, usually plays no part in the intentions of such owners, and all management has in view merely the protection and maintenance of such forests in their natural state. In cases such as these we have reached the borderland of forestry and another art which is sometimes confounded with it, the art of landscape gardening. It is, of course, possible to

manage a forest with a view both to profit and to the beautification of its landscapes, although usually one or the other of these objects will suffer. Something like this is done, for instance, in a portion of the celebrated Biltmore forest in North Carolina. But landscape gardening is an art ministering to the luxury of the well-to-do. Its object is beauty. Forestry deals with one of the first necessities of life; its only end is usefulness.

We have enumerated the most important ends which private parties may have in view when they become owners of woodlands. In every case they hold such property for their own benefit, either to derive a profit from harvesting the products of the forest, or in the expectation of deriving an advantage to some other business in which they may be engaged. The methods pursued by them in the management of their forests are decided by the question, What will pay the best? No method of forestry ever will be adopted by private owners unless, directly or indirectly, it pays in dollars and cents.

The private owners of woodlands, however, are not the only parties interested in the rational treatment of the forests of North America. The entire public, and the federal, state, and local governments as its representatives, has the deepest possible concern in this subject, for on skilful forestry depends the supply of one of the greatest necessities of civilized life, and with improper forestry methods several of our most important industries must

soon begin to decay. Besides, the extent and character of our forests has a powerful influence on the climatic and physiographical conditions of the country. It sometimes happens that the interest of private owners and those of the public are opposed to each other. In such cases it is the duty of wise governments to endeavor to change, by legislation, as far as possible, the conditions which cause such conflicts of interest, and in extreme cases to restrain the injurious acts prompted by private greed. A discussion of such measures of this sort as may at present be advisable in the United States must be reserved for a succeeding chapter.

Besides being the protectors of public interest in the management of private forests, both the federal and many state governments are also the owners of large areas of timber-lands. Most of the States to this day have no intention of permanently retaining the title to them, but try to dispose of them as fast as they can. Formerly this was the universal custom, but within a few years both the federal government and several of the States have come to the conclusion that it would be wise for them to keep the possession of a certain amount of forest lands. A few States, notably Pennsylvania and New York, have even appropriated large amounts of money for the acquisition of such tracts.

A government owning and managing forests may, like private persons, do so with several objects in view. It may manage them for the purpose of

obtaining a revenue; and in doing so it may calculate its profit either upon the cash outlay, with compound interest, without considering in the computation the rental value of the soil, or it may include the latter. In either case the methods of treatment adopted will be somewhat modified. As yet no American government has ventured upon such an enterprise, but either system of state forestry is in full working order in several European countries. Which of the two systems is adopted depends on fiscal rather than forestal reasons.

A government also may manage its forests with a view to furnishing a steady and ample supply of raw material to the industries of its people. In such a case it would be of secondary importance whether the forest afforded a large or small revenue. It might even be expedient to run it at a loss. Upon this system many of the public forests of Europe were managed a hundred years ago, but at present the aim to produce the largest possible revenue has almost entirely superseded it. The system is akin to that of a furniture manufactory which raises its hard woods on its own land; or the manner in which the farmer treats his timber-lot.

A third object of the management of public forests may be the protection of the climatic and physiographical interests of the country. The setting aside of large forest reservations in the mountain regions of the West by the United States government has been principally for this purpose. The States of Pennsylvania and New York also

consider their public forests in the first place as protection to the waterflow of their rivers and the fertility of their valleys. Such forests are usually located in the most rugged and inaccessible parts of mountain ranges, where forestry for revenue is generally unprofitable, either because the sterile soil does not produce good timber or because the transportation facilities are insufficient. Forestry operations in such localities are mostly confined to measures protective against injuries from fire and other causes.

It cannot be the object of a book like this to set forth in detail the various systems of forest management in existence. A voluminous literature is extant on this subject, and in order to treat it at all adequately, a mass of technical detail would be necessary that can be of no interest except to the professional forester. My aim is merely to give intelligent men a clear idea of what forestry really means, and I hope that by this time attentive readers have learned that it is simply a matter of business, usually a question of dollars and cents. It remains to give to readers entirely ignorant of the manner in which forests designed for continuous wood crops are treated, an outline of the nature of such operations. This is less for the purpose of showing them how forests are cultivated, than in order to clear their minds of some erroneous notions. Such erroneous ideas are at the bottom of much of the popular resistance to forestry reform.

In the first place, not a few people imagine that

the ordinary way of reproducing forests is to plant trees. When they contemplate the immense extent of forest area in the country and the outlay which replanting even a moderate proportion of the deforested tracts would involve, the enormity of the task appalls them. They flout the possibility of such an enterprise, and in the belief that this is what forestry reformers are advocating, set the whole tribe down as impracticable visionaries. This state of mind used to be more common than it is, but it is still encountered far too often. Now the fact is that the planting of nursery trees, or even the seeding of trees in the places where they are to remain, is but a last resort in forestry. It is not so much that it will not pay. For under reasonably favorable conditions the final harvest will yield enough to net a profit even where the original outlay of planting has reached twelve or fifteen dollars per acre, which ought to be considered the outside limit of cost. Ordinarily it will be found much lower, especially where the forester has his own nursery, as he would in most cases. But the trouble is in finding capital willing to be invested in an enterprise that will not return it for so long a period as is required to develop merchantable timber out of seedlings.

Fortunately, the planting of trees on entirely denuded tracts is necessary in but few instances. The greater portion of American woodlands is in the condition of culled forests, that is, forests from which the merchantable trees have been cut, leaving

the younger individuals, as well as all trees belonging to unmarketable species. Even on the areas where the lumbermen have made a clean cut of the original timber, new trees will come up of themselves, from seeds blown from the surrounding forests, or falling from occasional individuals left standing. At first the new growth of trees is apt to come up in scattered groups; but as these first comers arrive at an age where they bear seed themselves, they fill up the spaces with their offspring, and after a while the whole tract is again densely timbered—always provided that fire, cattle, and other injurious causes have not hindered the normal development.

While thus nature herself provides, in most cases, for the reforesting of the lands man has denuded, it does not follow that all the art of the forester should do under such circumstances is to protect the young wood from injury. That would be much, a great deal more, in fact, than is ordinarily done in this country. But it would be very far from getting the best result, that is, the largest amount of cash when the crop is harvested again. Many people probably imagine that a primeval wood, "by nature's own hand planted," cannot be surpassed in the number and size of its trees, and consequently the amount of wood to be derived from it. But the very opposite is true. No wild forest can ever equal a cultivated one in productiveness. To hope that it will is very much as if a farmer were to expect a full harvest from the grain

that may spring up spontaneously in his fields without his sowing. A tract of wild forest in the first place does not contain so many trees as might grow thereon, but only so many as may have survived the struggle for life with their own and other species of plants occupying the locality. Many of the trees so surviving never attain their best development, being suppressed, overshadowed, and hindered by stronger neighbors. Finally, much of the space that might be occupied by valuable timber may be given up to trees having little or no market value. The rule is universal that the amount and value of material that can be taken from an area of wild forest remains far behind what the same land may bear if properly treated by the forester. It is certain, therefore, that in the future, when most American forests shall be in a high state of cultivation, the annual output of forest products will, from a much restricted area, exceed everything known at the present day.

It is the business of the forester, therefore, to see that the land bears as large and as valuable a crop as possible. For this purpose he uses the axe far oftener than the planting tool—another idea that will come with a shock of surprise to not a few. One of the most common silvicultural operations is a series of what are known as improvement cuttings, that is, the cutting away of a proportion of trees where they grow so thick that they hinder each other, the elimination of species that are not wanted and take up the room required for more

valuable kinds, and the removal of sickly or crippled individuals that can never become good timber producers and may even infect sound neighbors with their own malady. There are certain rules according to which the trees are allowed to grow thickly together or farther apart, according to the object aimed at in each particular time and place. It is surprising to see the extent to which the forester can regulate the manner of growth of trees and the character of wood produced by them. As a general thing saplings should grow close together for a series of years. This forces them upward into long, clean shafts with few branches. Thereby clean, straight timber is produced. For the presence of each branch produces a knot in the lumber sawed from the log, and thereby reduces its value. The longer a branch is allowed to grow, the larger will be the knot. If the trees stand close together, not only will fewer branches be formed, but those existing on the lower parts of the trunk will soon die off for want of light. This process is technically called the cleaning of the shafts.

After a number of years a time comes when height growth is no longer the first thing to be aimed at. The object now must be to cause the young tree to increase the diameter of its trunk, and thereby the size of the logs that will some day be cut from it. In order to accomplish this, a portion of the trees is removed, this giving the crowns of the rest a chance to develop. With the broadening and filling out of the crowns comes also an

increased accumulation of wood in the trunk. Naturally, in making these thinnings, individuals that are of particularly vigorous development are favored, and their weaker fellows selected for the axe. Such thinnings are repeated from time to time. They require the exercise of much skill and discretion on the part of the forester, for besides the growth of the saplings several other things must be considered. For instance, care must be taken that the fertility of the soil is not injured by too much light being admitted to the forest floor. In such cases, what is known as raw humus is apt to be formed,—a kind of peat generated on dry land, which, like its kin in the bog, is inimical to most forms of plant life. Too much thinning may also cause the invasion of an excessive growth of weeds, either of grasses, herbs, or underbrush, which may hinder the reproduction of the desired species. Various other objects are attained by light or severe thinnings, as occasion may require. A discussion of these would lead us too far into silvicultural details of purely technical interest.

Nor can we give a detailed description of the various systems of silviculture known to foresters, each of which has its peculiar advantages and drawbacks, making sometimes the one, then the other, most adapted to existing circumstances. A few of the most important of these systems we may mention in passing. A forest may be composed of trees all of the same species and the same age; consequently, the time when it will be most

profitable to cut them down will be the same for the whole body of timber. If an owner wishes to have a regular annual revenue from his forest of this kind, he must evidently have a series of timber bodies of different ages side by side. For instance, if the cutting age is a hundred years, he must have a hundred bodies of timber, each a year apart in age, from the one-year-old seedlings to the hundred-year-old ripe wood. Such a system is known as a normal forest, which, however, probably nowhere actually exists in its complete form.

Again, the same body of timber may contain individuals of all ages, from the seedling to the ripe wood. In this case, the trees arriving at the cutting age are each year culled out. This system of culture is known as a selection forest. Like the preceding form, it is rarely found in its complete development. Some of the age-classes are usually missing, for reasons springing from the phenomena of struggle for life outlined in Chapter II.

Forests may be composed entirely of one species of timber trees, or a number of species may grow together on the same tract. We speak accordingly of pure or mixed forests. Either form is favored by foresters, according to various considerations.

An interesting form of forest culture is occasionally adopted under special conditions, and is known as coppice wood. Some trees among American species—for instance, most oaks, many maples, and the basswood—have the capacity of sending up shoots from their stumps, or stools. These shoots

sometimes reach considerable height and diameter, although they never attain the dimensions of the original trees. One of the advantages of coppice woods is the short periods within which successive crops can be taken. Where merely fire-wood is desired, coppice is profitable. Where oak bark is produced for tanning, it is the usual form of culture.

The treatment of a given tract of forest is rarely determined by purely silvicultural reasons. This would be the case if simply that form of treatment and those species of trees were adopted which, under the particular conditions of soil and topography, would produce the most and best timber. But as the ultimate end of forestry is not the production of fine trees, but the gaining of a profit, other considerations must modify the policy of the forester. These considerations are especially those of transportation and of market price. Without going into details, we will in the following chapter briefly treat of these and a few allied matters. In doing so our principal aim will be, as it has been in this chapter, to make it clear that the whole subject of forestry is simply a question of business, of dollars and cents to the owner and of economic advantage to the community.

CHAPTER VII

FOREST FINANCE AND MANAGEMENT

FORESTRY resembles farming in this, that both operations are not conducted in a perfect manner unless it is sought not only to obtain the best possible crop a single time, but to provide for successive crops at the proper intervals. The great difference between the two industries flows from the fact that farm crops ripen annually, while wood crops can be taken from the land but once at intervals ranging, according to the species of trees and the character of the product desired, from twenty to one hundred and twenty or more years.

How is the time known when a forest is ripe for felling? It is determined by a series of considerations, partly arising out of the natural qualities of trees, partly out of financial reasons. When a tree is very young it is not good for much of anything, aside from such special uses as hop-poles, Christmas trees, and the like, for which there is a limited market. Even when a tree has become large enough to furnish lumber, the wood may not be of the kind which is best for general use; for instance, small pines have too large a preponderance of sap-wood over heart-wood, and the lumber made from it is

not so strong as that cut from older trees, and consequently does not bring so high a price. Again, when a tree gets too old it is apt to rot at the centre, thereby diminishing the quantity of sound lumber it will furnish, even though it may still form a new layer of wood every year. Another factor is the different rate of growth of trees at different ages. Take the white pine and its cousins, for instance. The first three or four years the little seedling grows but very slowly, except as far as its root-system is concerned. Then comes a period, which may last from thirty to fifty years, when its growth is very rapid. If the young pines stand close together, as they ought to if good lumber is expected from them, this growth is especially rapid in an upward direction. After that period, they ought to be made to grow principally in diameter, and that is done by cutting out a certain number of the trees, so that the rest may have a chance to spread their crowns. As soon as they have done this and formed a full, leafy top, they devote themselves to increasing their diameter, without, however, ceasing to grow in height. This diameter growth may continue for an almost indefinite time. Pines have been known, that were over three hundred years old, as shown by their annual rings, and still formed new wood in their boles up to the time of their felling. The amount of wood so formed every year begins to decrease after a certain time, and in very old trees is apt to be inconsiderable. The rate at which the increase of wood takes place, at the different

periods of the life of a tree, is fairly constant among trees of the same species grown under similar conditions. It is possible, therefore, to ascertain by taking the average of a very large number of trees felled and examined, to calculate the probable increase of wood which other trees, still growing, will show at any given period of their future lives. Tables furnishing such information are known as yield tables, and have been, in Europe, constructed with great care, for all trees of commercial importance in that country. As far as is known to the author, as yet no such tables have been constructed and published regarding American trees, except a set, prepared by Messrs. Pinchot and Graves, for white pine grown in the mountains of Pennsylvania, and another for spruce in the Adirondacks.

These are some of the considerations growing out of the botanical nature of trees and required for determining when a forest is ripe for the axe. Clearly you must not fell the trees while they are still so young as to furnish little and inferior lumber; but while you may know, in this way, the lower limit of felling, you have not yet sufficient data to find the upper limit. You cannot tell whether you would most profitably cut your forest at a hundred or two hundred years of age, for it is clear that, barring accidents, the longer you wait the more lumber you will harvest. The upper limit, however, is set by financial calculations in the following manner:

It costs something to keep your forest untouched, and yielding very little revenue, year after year.

First there is your original investment, with interest at the current rate, — compound interest, too, for, as in a different kind of investment you might draw your interest annually and either consume or reinvest it, you are evidently entitled to get something for forbearing to draw out of the business. Then there is the cost of maintaining your forest, which will vary considerably according to circumstances. In this item you must include such preliminary expenses of surveying and otherwise examining your forest as may have had to be incurred at the start, in order to make intelligent plans for the way in which you want to manage it. You also include herein the cost of labor every year, the cost of superintendence by a skilled forester, not forgetting to reckon the interest on these items of outlay. Next you must think of the expense incurred for necessary tools and implements, as well as other plant, their wear and tear, and again the interest on the outlay. Still another item of expense will be the preparations for marketing your crop, which may include not only plant and labor, but also the expense of building roads. Finally, there are taxes to be paid—an item of cost of which we will have something more to say anon. All these things are to be paid for between the beginning of the business and the final harvest. There are, during this interval, certain sources of income from your forest, consisting principally of the money to be made out of material taken away by thinnings and other kinds of improvement

cuttings. These sums, together with the cash received at the final harvest, must evidently be equal to the cash outlay with compound interest at the usual rate ; else you would have done better if you had invested your money differently, and your forestry has not been a financial success. Strictly speaking, we must consider still another factor in order to judge of the profitableness of the enterprise. It may be that the land you maintain as forest has risen in value to such an extent that you would have realized more from a sale of the land than from your wood crop. At any rate, the increased market value might be taken into consideration, but I believe that it is neglected in the calculations of most forest estates, the world over, principally because there are often motives for not disposing of the land aside from the hope of larger returns by holding it.

The longer the interval between the beginning of forest growth and the final harvest, the greater is, manifestly, the amount of cash that must be received in order to make a profit on the investment. The increase of cash is, generally speaking, determined by the increase in the volume of wood contained in your forest. Now we see how we can find the upper age-limit for felling our trees. We have learned that after a certain age the amount of wood annually formed gradually decreases. The time for cutting most profitably is, therefore, the year when the increase in volume of wood no longer exceeds the annual cost of

maintaining the forest, reckoned as we have just shown. This time can be predicted in advance with considerable accuracy by the help of the yield tables, of which we have spoken above.

The time when the cut is made in practice is not always the exact year so ascertained in advance. It may happen, to take but one of many contingencies, that a year before the time set for the final harvest the market price of the particular kind of lumber produced in our forest is exceptionally high; then it would evidently be the part of prudence to take advantage of this accident, and possibly by the increased price realize more than would be represented by the wood increase of a single year. Or the reverse may happen; prices may be unusually low in the year when ordinarily the final harvest must come. Then we had better wait awhile till prices rise again.

The slight modification brought about in the time of the final harvest is not the only way in which market price becomes a factor in determining the system according to which a forest is managed. It may, among other things, affect the choice of the species to be raised on your land. It may happen that, from a purely silvicultural standpoint, your land is best adapted to one kind of tree. But you choose deliberately to raise another kind, because you foresee that it will find a readier and better market than the first. The difficulty of forecasting the market price is naturally very great, on account of the long periods of time with which

you must deal. Who can be certain what economic changes affecting the market for your commodity may occur in a hundred years? Still, as in agriculture there are certain staples which will always be in demand, so there are in forestry. The kinds of wood used in building, and for ordinary rough work, such as pine and spruce lumber, are not likely to ever fall into disfavor. It is different with many of the hard woods required for furniture and other manufacturing uses. Among other things, these are subject to the changes of fashion, which may at one time destroy the market for wood theretofore in common use, and at another bring a wood that was despised as valueless into favor and consequently into the high-priced class. It is not very long ago when the common red oak was considered valueless except for fuel. To-day none other of our oaks is in greater demand by furniture makers. New uses have recently been found for quite a number of woods that once were unsalable. This has been brought about, for example, by the introduction of excelsior, the more wide-spread use of wood alcohol and similar distillatory products, and especially the use of wood pulp in paper making.

While the species which, like the pines, furnish lumber principally for building and other rough uses have the advantage of a surer and steadier market, the other kinds of trees, required for special uses, generally speaking have the advantage of higher prices. They also, in most cases, may

be harvested at shorter intervals, which is an advantage, especially where your forest is a small one.

The cash returns one may expect from his forest are strongly affected by the facilities existing for bringing one's product to market. The question of transportation can, of course, like other questions of this sort, be treated in nothing more than the faintest outline in a volume like this. It is very closely bound up with the whole economic life of the nation, and an exhaustive treatise on the transportation of forest products would be in effect a treatise on the whole transportation problem.

The cost of transporting forestry products naturally divides itself into two stages. The first covers the way from the forest to the mill, the second the farther journey of the finished product into the hands of the consumer. Perhaps one might say that only the first division properly falls within the field of forestry, and we will direct our attention principally to it.

The business of sawing logs into lumber is very often conducted by other parties than the owners of the forest where the trees are felled. In most foreign countries, I believe, this is the rule, while in this country the opposite case is perhaps more often to be found. But no matter how soon in its progress to the consumer the forest product changes ownership, the question of transporting it is of the utmost importance to the forester. There are to-day billions of feet of timber in this country which, from a silvicultural standpoint, ought to be

cut without delay, but which cannot be touched by the axe on account of the lack of transportation facilities. As these bodies of timber are in danger of constant deterioration from the numerous causes treated elsewhere, there is here a distinct loss of natural wealth, due directly to the absence of roads of all kinds.

We have described in another chapter some of the manifold devices adopted by our lumbermen to bring their heavy and unmanageable goods to market. The distinguishing feature of all road building by American lumbermen has been that these works were of a temporary nature. Even railroads built by the loggers are put up hastily, cheaply, and without a durable and smooth roadbed, so that in case the logging railroad is later on wanted for permanent railway use, as happens not rarely in the progress of settlement, both roadbed and rails must be practically laid anew. The justification of this rough kind of work lies in the fact that lumbermen have not heretofore had occasion to care for a second crop to be taken from their lands in the future. Consequently the roads were of no further use after the growing timber had been removed, and expending money to insure greater durability would have been wasteful. If in the future forestry methods are employed looking towards a continuous succession of crops, it would be wasteful to fail of building permanent roads, as the expense incurred in building temporary ones would have to be repeated every time

the period for cutting timber came around again. Besides, the roads are necessary during the intervening silvicultural operations, such as improvement cuttings and so forth, and they serve as effective fire-breaks. In a permanent forest estate the sinking of a considerable amount of capital in road building cannot be avoided; but hardly any employment of capital upon the estate is calculated to give a greater increase of value than this, provided, of course, that it is done judiciously and without excessive expense.

We have now outlined the main principles which must be the guides in choosing the manner of treating a forest from which we expect to derive a continuous series of profit upon the investment. First we mentioned the purely silvicultural factors, the questions depending on the nature of the climate, soil, and topography, and the manner of growth of trees. Then we considered the financial side of the question, the calculations regarding the amount of capital needed, the rate of interest, the price to be expected for the crop, and the facilities of bringing it to market. We could not do more than mention the elementary principles on which these considerations are based, for to treat even one of them in detail would far exceed the limits of this volume, besides being of little interest to most readers. But this I hope to have made clear to all,—that for the successful management of a permanent forest as a profitable investment it is of the greatest importance that the

beginning be right. You must raise the right kinds of trees in the right places, and lay out your plans of treating them in advance. For your crop cannot be changed for a long time after you have started it and, unlike the farmer, a mistake made in one year cannot be corrected by you in the next. The making of the working-plans for the treatment of a forest is rightly considered as one of the most important as well as the most difficult parts of the professional forester's art. The larger the forest the greater are, of course, the difficulties of making it, but even the smallest wood-lot ought to be treated according to a well-considered plan in order to realize the highest benefit for the owner.

Where a person has invested a considerable portion of his fortune in forest property it may be assumed that he desires a continuous annual revenue therefrom. As it takes a great many years before a body of timber becomes ripe for the final harvest, and the intermediate revenues are hardly large enough to satisfy the wants of the proprietor, the only way out of the difficulty is to divide the forest into different bodies of different ages, so that one of them may be ripe for the axe every [illegible] from this it follows easily that forestry [illegible]ss by itself, not merely supplemen[illegible] to farming or manufacturing enterprise, pays only on a large scale, for only in that way can a sufficient cash revenue be realized every year to pay reasonable interest on the investment. The divisions and

subdivisions into which a forest is usually divided are technically known as blocks and compartments. They serve to mark the body of timber to be felled each year, and are also convenient for various silvicultural purposes. The number of compartments ought to correspond, as nearly as possible, with the number of years which the trees require to become ripe for the axe, according to the principles already explained. In a forest so arranged there will, consequently, be trees of every age, from the seedling to the ripe timber. It should be said that what has just been stated applies especially to the system of silviculture known as normal high forest. In such systems as selection forest or coppice, considerable modifications in applying these rules are required, but the principle remains the same. In all cases the forester's aim is to have a sufficient quantity of timber ready for marketing each year, and to provide annually for the future supply of timber by beginning a new reproductive cycle to supply the place of what has been removed. The period elapsing from the time when the young seedlings begin to sprout to the year when the mature trees are cut is known as the rotation period. One speaks accordingly of a sixty-year rotation, a hundred-year rotation and so forth. Generally speaking, the production of ordinary lumber requires the longest rotation. Where it is intended to raise special kinds of lumber for manufacturing purposes, or wood for pulp material, charcoal, or other industrial uses, the rotation is often materially shortened.

I trust that from what has been said in this and the preceding chapter, attentive readers, even if entirely unfamiliar with the subject before, can form a conception of the character and objects of the improved methods of forestry now so widely and zealously advocated in this country. The next matter to be considered is how far such methods are applicable to the condition under which American forests must be utilized by their owners.

The dead-weight of a stupid repugnance to all change, which is encountered by every advocate of improvements, opposes itself also to forestry reform. Without having even a hazy notion of what is proposed by the reformers, and being too lazy to inform themselves upon the subject, not a few in some respects, quite intelligent people content themselves with saying that the methods possible in little Germany cannot be applied to our immense country, with its inexhaustible resources. In order not to fall into the same error with our antagonists and judge of things we know not of, we ought to examine what modicum of truth there is to this objection.

Always bearing in mind that the chief end of forestry is to make money, let us see whether the producer of timber, who looks to a succession of crops from his forest, can hold his own in competition with the lumberman, who merely seeks to market the store of timber provided by the forestry methods of nature. To begin with, there is no doubt but what the provision for forest reproduction

entails a considerable expense to which the ordinary lumberman is not subject. Yet this would be no obstacle if the capital so sunk were certain to return into the pocket of his owner with reasonable profit. Can it be expected to do so with any degree of certainty?

There was a time when the amount of merchantable timber in our natural forests was considered as practically inexhaustible. To-day no intelligent man believes it so. White-pine lumbering on a large scale will cease within ten or fifteen years. Its place will be taken by the southern yellow pines, and to a smaller extent by the various soft woods of the West. But this supply also will give out in a not distant future, especially if consumption goes on increasing in the way it has done of late. If land-owners were to begin restocking their cut-over land at the present time, they would have their new growth in merchantable condition just about the time when the last remnant of natural supply will give out, and would be in condition to supply the market practically without competition from naturally grown timber.

This conclusion is so obvious that the very fact must make us suspicious. The men who stand at the head of the great lumber corporations are certainly, as a rule, men of great ability, wide experience and large knowledge in the sphere of their business. They are ever anxious to adopt new methods by which their operations can be made more successful. If the matter were so plain as we

stated it above, these men would have discovered the fact long ago and gone into the business of raising young forests. The lumber business is usually conducted by corporations which continue when their officers die, so it cannot be a reluctance to invest in an enterprise from which returns do not come in one's own lifetime. Moreover, these concerns have such great means that they could well afford to have a portion of them tied up in Wisconsin during the time when the new growths were slowly maturing on the cut-over lands, while with the rest of their capital they were harvesting the original pine in the South. Then why do they not do it?

Some of the answers occasionally given are quite insufficient to account for this singular circumstance. One of the commonest objections heard, at least in the Lake region, to any plan for the restocking of denuded lands with pine, is that the pine will not grow there again. I speak of pine in this connection, because with its allied soft-wood species it will always furnish the greater portion of material for the lumber industry. This notion is based on an erroneous analogy drawn from agriculture. People imagine that a rotation of crops is needed in the raising of trees as well as of grain, while for reasons we need not discuss here the case is quite different. Observation, if well directed, will easily convince one of the fallacy of this notion, for in all parts of the pine regions of Michigan, Wisconsin, Minnesota, and Ontario, young

pine is coming up lustily, wherever seed has reached the soil and the fire has given the young growth a chance. These small white pines, however, are not rarely mistaken for jack pine by the inhabitants of the region! A circumstance which often prevents a careless observer from recognizing the new growth of pine is, that the cut-over lands almost invariably cover themselves at first with rapidly growing broad-leaved species, such as the aspen (*Populus tremuloides*, Michx.) and paper birch (*Betula papyrifera*, Marsh). Under the light shade of these trees the little pine seedlings increase slowly in height and vigor, until after about fifteen years they begin to overtop them, and gradually by their own shade kill the trees that have protected them in their infancy. In Maine and the other eastern lumber regions there seems to be no such superstition about white pine not reproducing itself, probably because there the second growth is by this time of such age and size that even the most superficial observer cannot deny its existence.

Another way of explaining the reason why reforestation has not yet recommended itself to the owners of pine lands is hardly more founded on fact than the legend that pine will not grow again in its old habitat. It is sometimes said that the reforestation would be too expensive to bring profit from the final harvest within the bounds of probability. Let us see what there is in that.

Undoubtedly the ca[illegible]se to be incurred by the American foreste[illegible]or the labor required

in silvicultural operations is higher than it is in Germany or France. Just how much higher, it does not matter for our purposes. But American labor is more effective than European. In nearly all industries it is a well-known fact that a workingman in the United States accomplishes more work in the same time than his fellow in Europe. There is no reason to doubt that the same rule will hold good in forestry work. In addition, we may count on the usual labor-saving devices, as soon as Yankee ingenuity has been turned upon silvicultural problems. Consequently we may expect a counter-weight to the apparently greater cheapness of European labor. In another regard we have the advantage of Europe. That is the value of the land. Five dollars an acre is considered a pretty high price to pay for timber-land in the United States, while immense tracts can be had for far less than that. In Central Europe values are very much higher, if we except mountainous regions where forests are maintained less for the revenues they will yield than for the indirect benefit to be derived from them. It is plain, therefore, that there can be little, if any, difference in the average cost of maintaining forests for continuous crops in the United States and Central Europe under the same system of management. But can the European forester expect a substantially higher return from forests grown under approximately similar conditions ?

This question must be answered principally with

reference to market facilities and market price. In one respect we are undoubtedly at a disadvantage to the European. His forests are mostly in close proximity to densely populated districts. Consequently he has a market for a number of minor forest products which we cannot utilize. He may sell the nuts, berries, and mushrooms growing in his woods, although in many cases a benevolent custom allows the poor people of the neighborhood to avail themselves of this not quite inconsiderable revenue. There is very little waste in felling, for the branches and tops, which we must leave on the ground as a constant menace of fire, he binds into fagots and sells at a reasonable price for fuel and other purposes. The cost of transportation from the mill to the consumer is apt to be less. As to the average price of lumber in Europe and this country, it is not easy to make accurate comparisons. In the first place, in Central Europe at least there is comparatively little use made of soft-lumber boards, most of their spruce and fir timber being used in the shape of beams, while nearly all our pine, spruce, and fir lumber consists of boards. It is rather difficult to make precise calculation in converting the price of one of these into that of the other. Moreover, prices in Germany and France are quoted for the cubic metre, while we use the foot board measure as the unit. This adds another element of difficulty and uncertainty. If one wants to compare the prices, not of sawed lumber, but of logs, in the forest or at the mill, the first difficulty

is eliminated, but the second remains. On the whole, I think that hard wood brings materially higher prices in Europe, but the market price of soft-wood timber is nearly the same there as in the United States. Still, I am not by any means certain that this conclusion is quite correct.

Assuming that the European forester receives a higher price for his crop, yet the high rental value of his land compels him to wring from the soil the very greatest amount of cash it can possibly yield. In other words, his forestry must be what political economists call intensive, just as the European farmer must resort to an intensive cultivation of his high-priced land in order to compete with the farmers of our western States and other countries with low land values. This increased productiveness of the land can be brought about only by the employment of additional capital and labor. Now, everybody who has ever studied political economy knows the law of diminishing returns, which is briefly stated as follows: There is a point where the application of capital and labor upon land brings the highest return in products, in proportion to the cost. If the amount of capital and labor so applied is increased still further, the amount of products resulting will increase absolutely, but the proportion it bears to the cost of production will become smaller and smaller. In other words, the cost of production will increase more and more until finally the further increase of capital and labor so applied becomes unprofitable. This law is as effective in forestal as

in agricultural operations. It follows from it that Central Europe, with its high cost of production (high notwithstanding its lower money wages), must receive higher prices for its forest products in order to make forestry pay, just as it must receive higher prices for its agricultural products in order to make farming profitable. In the United States we will not for a long time be compelled to resort to intensive methods of production; in fact, such methods would in most cases be ruinous because we would not have a higher market price to off-set the increased cost. But giving due weight to these facts: that the cost of labor in Europe is only apparently less; that the rental value of the land there is much higher; and that, with increased cost of production, the price of staple products is little, if at all, higher in Europe than here, it seems that we have even a better chance to make forestry pay than they have there, just as on the whole farming is more profitable in the United States than in Europe.

Still another consideration must not be forgotten. If forestry based on silviculture were begun to-day, its product would not be ready for market until about the time when the merchantable timber provided by nature had disappeared. The wild and the cultivated timber would therefore not come into competition at all. The producers of the new supply would hardly underbid each other to any extent so as to lower the price below the cost of production. As to foreign competition, it is impossible to say with any certainty whether there will be, seventy-five

years from now, a supply of soft-wood lumber anywhere, able to compete with home-grown lumber in sufficient quantity to disturb the market. But assuming that such competition will be possible, we may consider it as the settled policy of the country, in cases of this kind, to protect itself by tariffs on importation, and in the supposed contingency such measures would undoubtedly be resorted to.

After all this has been said, the fact remains that our lumbermen do not provide for a future supply of timber. We must repeat the question: Why do they not?

The true answer can be summed up in two words: Fire and taxes. But before we discuss further these important factors in the forestry problem, we ought to devote a chapter to considering the interest which the State and federal governments have in the matter. After we have done so we may be in a better condition to understand the part played by the government in the question of fire protection and taxation of forest property.

CHAPTER VIII

FORESTRY AND GOVERNMENT

GOVERNMENT may have an interest in forestry matters in two different ways: It may be the owner of forests, or it may find that the general welfare of the country is seriously affected by the manner in which the forests are managed, and therefore desire to regulate such management to a greater or less extent.

As everybody knows, the government of the United States has from its incipiency been the greatest land-owner of the country. A very large part of its land was and still is covered with original forests. The policy of Congress has been until very lately to dispose of these public lands to private parties to be utilized for agricultural, grazing, mining, or lumbering purposes, as the case might be. At first the lands were sold outright, a policy which resulted in large tracts going into the hands of speculators. Then various devices were tried for making sure of the lands being taken up by actual settlers. The most important of these devices was the Homestead Act of 1862, with its amendments, by which patents to not to exceed 160 acres are issued, without payments except a

small registration fee, to any settler after he has resided on the land and improved it for five years. Large tracts were also granted to various railway companies, in aid of their building railroads through unsettled territory, and all of the new States carved out of the public domain were given a part of the lands within their limits. The grants to States were mostly coupled with the condition that they were to be used in aid of various public institutions to be established, such as schools, universities, agricultural colleges, and so forth. Large grants were also made for drainage purposes, and the courts have held that the States had the right to judge how much of the revenue derived from them was needed for that object, and that they might divert the rest to something else. So this class of lands, at least, is held by the States virtually without being burdened with any trust. The States have mostly followed the example of the general government and disposed of these lands to private parties as fast as a demand was found for them. The result is that the older States which were benefited by these grants have but little public land left, while the younger ones still have considerable tracts, much of it not yet surveyed and patented. Suppose that a State should decide to retain possession of such public lands as are fit for the maintenance of forests, and manage them as such. What objects could be held in view by such a policy?

Clearly, the State might proceed just as a private

owner would, and attempt by proper silvicultural treatment to derive the greatest possible revenue from them. This policy is followed by many of the European states where forestry most flourishes, and it is well known that several of the states of the German Empire, as well as France and other countries, derive a very considerable part of their revenue from such public forests.

The objections to such a course are obvious, both from an economic and a political standpoint. They are the same objections which are usually urged against the conduct of a business enterprise by public authorities. Raising timber and other forest products for the market is not a proper governmental function. It smacks of paternalism and socialism, and is opposed to the settled policy of the American people. It would be folly to deny the weight of these objections. Without entering upon the controversy as to how far the adoption of socialistic measures might be wise, we may say that no American government will, for many years to come, enter upon the business of forestry simply as a convenient means of raising a revenue.

But there may be other reasons why it should be expedient to permanently maintain public forests, so that the revenue becomes a mere incident to more important objects. If a State, or the federal government, should become convinced that the continued existence of forests capable of producing commercial timber and other forest products was absolutely demanded by the public welfare,

and that private enterprise could not be relied upon to maintain such forests, then the policy of public forest maintenance might well be resorted to, notwithstanding the objections mentioned above.

I dare say that none but the extreme followers of Adam Smith would deny that government ought to shape its measures so as to prevent, if possible, the decay of so important a series of industries as those depending upon forests for their raw material. The majority of the American people, which favor a system of protective tariff, will not object to a reasonable internal policy of protection to so vital a source of national wealth as the forests, and if the people become convinced that nothing but government management can assure the permanency of forests, the bugaboo of "paternalism" or "socialism" will not terrify them.

Now, I am very far from arguing that it has been demonstrated that, taking the country as a whole, private forest management cannot be made a business success. I believe that even under present conditions it can, in many cases, be made to pay, and that as soon as by proper legislation the problems of fire protection and taxation, which will be discussed in the next chapter, have been solved, it will pay well in all localities where it is proper that forests should grow. But even if this is true, as the future will undoubtedly show, it will be wise to have by the side of private forest enterprises a system of public forests, managed according to the most approved business principles.

A forest, under reasonable natural and economic conditions, can be made the source of a fair, steady income proportioned to the investment. But like all safe investments, very large profits need not be expected. It takes more self-restraint than the average, speculative American has at his command in times of "boom" and business activity, when high profits are being made on every hand, to resist the temptation of turning one's growing timber prematurely into cash and investing the proceeds elsewhere. For after a certain age a forest lends itself very readily to being made cash. Although the trees may still be far from the age when they would be cut most profitably, they will yield a large quantity of lumber and find a ready market. If the owner should be in financial difficulties, the felling of his growing forest would be one of the best means of obtaining the money to save him. In Europe much of the private forest property is protected by entails and other legal devices to prevent waste. Still greater tracts are ancestral estates and their owners are restrained by sentimental reasons from destroying them, but even there it has been found by experience that private ownership cannot be trusted to prevent an excessive diminution of forest-covered area, nor to insure a rational treatment of forests. For this reason many of the European states are gradually purchasing more and more of the private forests for public management. In the United States we will probably find, for the same reasons, that

public ownership cannot be entirely dispensed with. Exclusive state forestry would perhaps not be desirable because it would create a state monopoly in the raw material of some of the most important industries. Such a thing is tolerable only under a despotic or a socialistic government. As long as we desire to have neither, a mixed system will probably be best, in which public and private ownership is represented in such proportion that permanency of supply is insured by the one and fair treatment of the consumer by the competition of the other.

There is a class of forests which ought to be maintained irrespective of revenue or questions of supplying raw material to industries. These are forests which protect the water supply of river systems. This branch of the subject has been given rather excessive prominence by most writers on forestry in this country, and a large portion of the public has been led to believe that it embraces the whole of the forestry problem. Much indiscriminate theorizing has been indulged in about the influence of forests on climate, rainfall, waterflow, and erosion. Much of this has not been verified sufficiently by actual observation or experiment to be at all above question. Some of the favorite statements of popular writers are directly false; others are true with important qualifications.

No assertion is more familiar than that the fertility of the countries surrounding the Mediterranean Sea has, within historical times, become

greatly reduced on account of the destruction of forests. It has not been established, however, that these countries had a very much larger forest area in ancient times, or that with rational methods of agriculture they would not be as productive to-day as they ever were. Just so it would be pretty hard to prove that any considerable portion of the North American continent is in danger of being turned into a desert on account of the destruction of forests, even if it proceeded with much greater rapidity. The whole question of the influence of forests on climate is still under investigation, and many more and systematic observations are necessary before it can be considered settled.

However, a few facts in this regard may be taken as above dispute. It is not improbable that the extent to which the general climate of a country is affected by forests is overrated, but they certainly affect the conditions in their own immediate vicinity. The absence from forest areas of the hot, scorching winds so inimical to agriculture on our treeless plains is one of the instances of such influence. Large areas of forest also seem to have a tendency, similar to large bodies of water, to lower the average temperature of summer and raise that of winter, but this is more doubtful. Whether forests tend to increase rainfall, as is often asserted, is, to say the least, not proven. The most conspicuous and best ascertained effect of forests upon natural conditions is the manner in which they regulate the flow of streams and surface water.

The humus accumulating on the floor of forests, the litter of dry leaves, the cushions of moss and covering of herbage have a tendency to soak up the rain-water and hold it much longer than it would be held by the comparatively thin vegetable covering of grass-covered areas, let alone slopes devoid of dense vegetation. The shade of the forest also retards evaporation of the water after it has fallen, and the tangle of dead trees, branches, and leaves often obstructs the flow of streams and causes the water to form pools and swamps that are drained but slowly. The tendency of forest covering is, therefore, to make the processes of evaporation, percolation of the ground, and running off of surface water proceed much slower than in the open country. Consequently, the rivers fed from forest regions are apt to have a more regular flow. The floods after heavy rains, or after the melting of the snow, will not be quite so high, and the low-water stage will not come quite so quickly after the rain has ceased. So much is certainly true. But it is not correct to assume that the great floods occasionally doing so much damage along the Mississippi and other great river systems have been caused by the destruction of forests around the headwaters. In the first place, the deforestation around these headwaters has not been excessive. In the second place, great floods were known long before settlement in these regions had made the slightest inroads upon forests, as can be learned from the notes scattered through the

writings of the early travellers. Much more conspicuous than in the floods of the great rivers is the influence of forest disappearance on the dwindling of small rivers and brooks, and the occasional drying up of springs. This process is quite noticeable in all regions that have been settled within the last fifty years; but it is by no means certain that the phenomenon is caused exclusively by the removal of forests.

The greater instability in the water stages of rivers, the more destructive freshets and protracted low water, which are characteristic of streams in a district with little or no forest cover, are, of course, injurious in many ways. But the greatest damage caused by them is that of over-erosion. A stream running rapidly at high water is a far more effective agent than a moderate stage of water in tearing away soil and carrying it down to be deposited where it may not be wanted. What is true of the river is true of the smallest rill. The danger of such excessive erosion is but small on plains or districts with slightly rolling topography. But among the hills and mountains it becomes very great. Where a forest covers the steep sides of a hill the rush of water into the valley is very much retarded, but on an open slope it can act with full force, as may be seen at every such hillside, where the rain-water is gradually wearing ravines into the surface. Where the mountains are deprived of a considerable portion of their forests, the streams occupying their valleys are sure to receive a much greater amount

of detritus than in forested districts, and the lowlands will gradually be rendered infertile by their soil being covered, at every freshet, with a layer of gravel and sand carried down from above. This experience has been had, among other places, in Pennsylvania, and has been among the chief reasons which have led that State to enter upon a course of reforestation at State expense. The State has begun to purchase large tracts around the headwaters of the Delaware, Susquehanna, and Ohio, with a view towards preserving them as forests, so that the harmful phenomena of over-erosion may be avoided. For the present, the question of obtaining a revenue from these lands by silvicultural operations is not considered by the authorities, although that also may come in time. Forests which are selected with such particular regard to their protective effect are likely not to be in such localities as would promise a very good crop of timber or proper transportation facilities. It need not be expected, therefore, that private parties ever will find it expedient to protect and manage them. In such cases it is absolutely required that the public authorities assume the burden, and maintain such forests even if they will be a permanent drain upon the public treasury. The money so expended will return into the pockets of the people with interest, through the protection that forests of this class afford to the welfare of man. If the land in localities where forests are required for protective purposes has already been transferred to private hands, the only safe way for government is

to reacquire the title to them. In some countries it is attempted to regulate the manner in which the private owners of such forests may manage them so as to keep them from endangering the public welfare by removing them or impairing their effectiveness as a protection. Such violent encroachments on the right of the people to do what they like with their own property are not to be thought of in this country, and there is nothing left but for the public to take such tracts into their own hands.

In the western half of the North American continent forests are almost exclusively confined to the mountain ranges, while the surrounding plains and plateaus are devoid of timber. As much of this region is arid or semi-arid, precipitation being largely confined to snowfall on the higher elevations, agriculture and every other form of civilized life is dependent upon artificial irrigation. The water for these works must be derived principally from the snows accumulating on the higher mountain slopes, and the forests covering the steep sides are of the greatest importance in protecting the irrigation works. Without them the floods at the time of melting snows and after heavy showers in summer would rush down with such impetuosity that the dams, basins, and canals could not withstand their force. The erosion of the mountain sides would be so great that the valleys together with the irrigation works would be quickly filled up with gravel, silt, and mud. The United States, which still holds most of the land in this region,

has seen the absolute necessity of preserving the mountain forests and has recently set aside a number of large forest tracts in various parts of the mountain regions, to be preserved as protective forests. We will, in a succeeding chapter, briefly treat of some of the discussions which have arisen out of the setting aside of these reservations.

There has been some controversy on the manner in which the Rocky Mountain forests act upon the melting of the snow and thereby affect the irrigation problem. It is actually argued by some that the presence of forests is injurious instead of beneficial. It is said that the forests prevent the drifting of snow and its accumulation in immense heaps filling the ravines and depressions. The comparatively light and evenly distributed snow covering in the forest melts rapidly and runs off into the valleys early in spring; the very deep snow masses filling the ravines do not melt until late in summer, and therefore supply a full stage of water long after the spring freshet has run by. There is some truth in this observation, but by no means as much as some of those advancing it imagine. In the first place, something depends on the character of the forest. In localities where it is rather thin, the drifting and filling of ravines is not by any means entirely prevented. On the other hand, where it is very dense, its own shade tends to retard the melting, in the same manner as the depth of the snow does in the ravines. Again, it must not be forgotten that much of the melting snow does not run off on the surface, but

percolates the ground. Necessarily, where the snow is all drifted together in certain localities, while the rest of the ground is bare, a much smaller percentage of the water has a chance to enter the soil than where the whole ground is covered and every square inch of it can absorb its share of moisture. The water so entering the soil is the source from which the springs and smaller watercourses receive their supply during the summer and continue to feed the larger streams long after even the snow masses of the ravines are melted.

There is a way of utilizing forests for the benefit of the community which comes properly, perhaps, within the province of the municipal and other local authorities rather than the State and federal governments. Forests are not merely places where raw material for human industries is produced, nor tracts of land which protect mountain sides from over-erosion and regulate the water-flow of the streams. They are also the great play-grounds of nations, where thousands flock to gain new health and vigor, physical, intellectual, and moral, and find a temporary escape from the strain and stress of modern civilized existence. The sportsman with rod and gun, the lover of scenery and outdoor life, would feel it a serious deprivation if he were robbed of the privilege of enjoying the cool shades of the forest. To the inhabitants of the regions where the forests are, the annual arrival of the city people, as tourists or summer residents, is a very important matter of dollars and cents. Not

a few small towns and villages in various parts of the country could be named which are absolutely dependent for their prosperity upon their reputation as "summer resorts." Notwithstanding this fact, and the constantly greater importance which the tourist and summer-resident business assumes, very little is done by the people who desire to derive the pecuniary benefit from it to make their localities more attractive. This is particularly true about the western resorts. The idea of a summer resort entertained by the average inhabitant of these places is a lake, a lot of boats and fishing-tackle, and a hotel, possibly a few cottages standing in the midst of an unkempt lawn with a few trees scattered over it. Of course, this is all very well as far as it goes, but what a mass of unused opportunities there is here! All over the Northwestern States, as well as in many other sections of the country, there are thousands of inland lakes lying in a country abounding with forests. Not rarely these woods are on hills and ridges unfit for agriculture. They are now in private hands, parcelled out among many small owners who have no use for them except for fire-wood. Being ignorant of the very rudiments of silviculture, these owners allow them to deteriorate from year to year, till finally they will be nothing but unattractive brushlands.

The summer residents would gladly enjoy roaming through these woods. They are soon tired of the monotonous round from the hotel piazza to the tennis ground, thence into the boat and out on

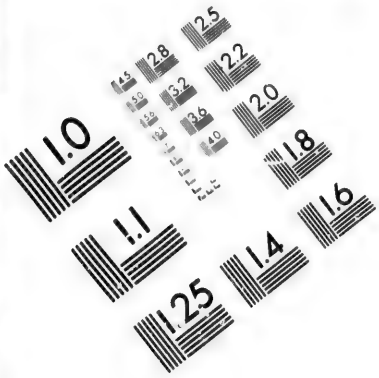
the hot, sunshiny lake. Fish and fishing become burdensome after a while; they would rather hear the thrushes and warblers, or see the rabbits skip through the underbrush. The woods are there, less than half a mile away, but to the majority of the summer guests as inaccessible as if they were on another planet. There are no roads through the woods. As if in mockery, the hotel-keeper advertises the fine drives of the surrounding country. But every road that an ordinary vehicle dare venture on runs through the sunny, uninteresting fields down in the valleys. The woods, where one would like to drive, are carefully fenced off, and only the more venturesome among the guests ever enter their shades. Then they are left to chance as to whether they get the most enjoyment out of them or not. There is no guide-post, not even a foot-path leading to the spot where that fine view of the lake can be had. The particularly fine group of large trees at the other side can be found only by accident, and then you must crawl through four barb-wire fences, which keeps the ladies from ever reaching the spot.

Such a picture is true of hundreds of American summer resorts, even some of the most famous ones. Nobody seems to think of the enormous advantage a place of that kind would derive if the picturesque surroundings were made accessible to the travelling public. Suppose that a tract of forest in the hilly portion of the neighborhood were in some way acquired by the village, town, or

county. Suppose the authorities engaged a competent superintendent, who would make roads and foot-paths, put up benches and other resting-places in the appropriate spots, and in other ways improve the tract for the benefit of the public. Would not such a measure add immensely to the attractions of the summer resort, and would it not easily outstrip all its competitors that lacked these accessible woods? But the expense, you say. Why, if the management were at all competent there would be no expense. The money to purchase the land would be borrowed, and thereafter the annual income from the forest, under proper silvicultural treatment, ought to be enough to pay running expenses, interest, and successive small instalments to repay the principal. If the public authorities did not care to undertake the burden, it would be almost as well if an association were formed for the same purpose. There could be no objection to a small toll being charged to vehicles entering the tract, and that would aid materially in defraying the cost. Such associations hold considerable tracts of forest land in the Adirondacks and other parts of the East, and cannot but be considered a benefit to the whole public, even where they are primarily organized for the pleasure of their own members.

Another branch of this subject deserves consideration. The tendency among the well-to-do all over the country now is to maintain their own private summer residences instead of spending their

vacations at summer hotels. There are many of those northwestern lakes I have mentioned the shores of which are entirely occupied by such summer residents. There are some considerable bodies of water where a tourist or other stranger cannot get to the water's edge without passing through somebody's private garden or park; or if somehow he has got into a boat, he cannot land anywhere without being a trespasser—not a mere technical one, but a trespasser whose presence is hotly resented, as is shown by the warning signs that greet him on every hand. This movement towards excluding the public from places of this kind will go on with increased speed until it has practically reached every available spot of beauty. Aside from the wrong thus done to the great mass of people for the benefit of a minority, what will be the effect of this change upon the permanent inhabitants of the region? At present they derive large revenues from the travellers by furnishing them with board, lodging, boats, vehicles, acting as guides, and so forth. But to this revenue the people who have their own summer residences contribute very little. They have their own boats and teams, get their supplies from the city, and hardly ever patronize the local tradesman. If they are allowed to drive out the transient visitors by more or less completely excluding them from all the beautiful spots to be found in the place, the permanent inhabitants will lose nearly all the economic benefits to be derived from the vacation season of the



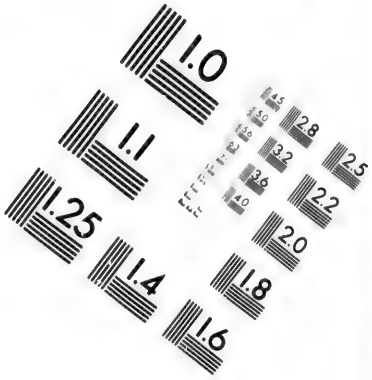
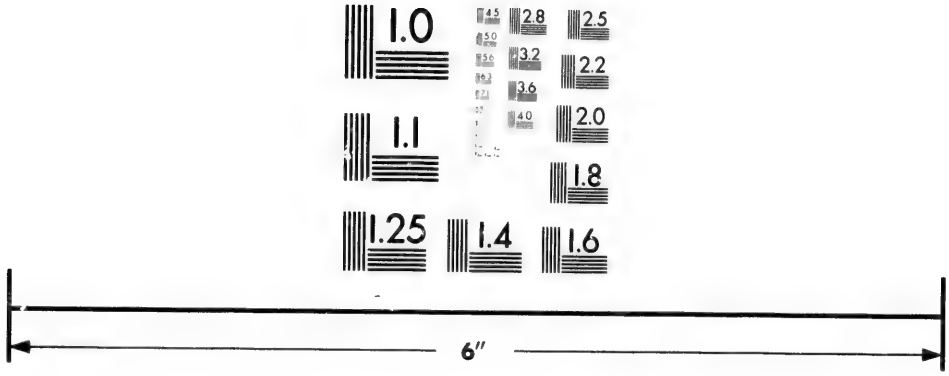
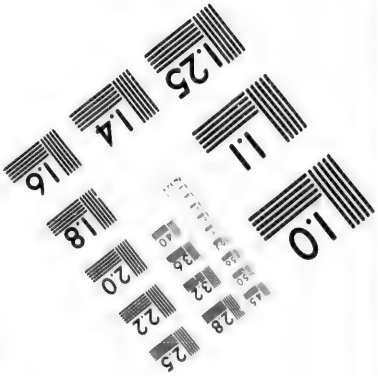


IMAGE EVALUATION TEST TARGET (MT-3)





Photographic Sciences Corporation

23 WEST MAIN STREET
WEBSTER, N.Y. 14580
(716) 872-4503

city people. The protection against this danger evidently lies in reserving a portion of the surroundings to the public by letting the local authorities, or associations, acquire the possession and manage these parks for the benefit of all.

There is one branch of forestry work, independent of the proprietorship and management of the woods, which is pre-eminently within the province of governments and public institutions. That is the acquiring and dissemination of information regarding our forests and forest industries. Work of this kind can be done by private parties to a limited extent only. The greater means of governmental agencies and of the great universities of the country are necessary to do it effectively. Facts regarding the life, history, and properties of trees; their relations to geological, topographical, and meteorological conditions; their interdependence with other plants and with animals,—all these have to be gathered, collated, and studied, if silviculture in this country is to be based on accurate knowledge instead of being forced to trust in chance. Much work has been done in this direction, mostly by men of science who had no immediate pecuniary interest in the phenomena they were studying. But the field to be covered, including, as it does, nearly all the natural sciences and extending over a whole continent, is so immense that all that has been learned is but an insignificant beginning of what should be known. What is true of the biological side of forestry is

also true of the economic side. Thorough and reliable information on markets, inventions affecting the use of woods, legislative measures in the various States, and economic conditions generally must be at the command of the forester for the proper conduct of his business. The owners of woodlands, the lumbermen, and other exploiters of forests cannot, as a rule, be expected to acquire such information for themselves, still less to publish it for the benefit of others. They rarely have the training required to make scientific investigations even of the simplest sort. If they had the ability, yet they would lack the time and inclination to do work of this kind. The work must be done, not for the interest of these exploiters merely, but in the interest of the nation, which needs the forest and the forest industries. Therefore it is eminently within the province of the government to provide means and men to do work of this kind. It must be said that both our federal and State governments have done more in this branch of forestry work than in any other, yet much still remains to be done. Just what the various scientific bureaus of the United States and of many of the States have accomplished in this direction, we will outline in another chapter. In this place we merely want to make the point, that no matter what our view may be regarding the expediency of private or public systems of forest management, we cannot deny that here is a great field for the activity of governmental agencies.

So far in this chapter we have treated the relations of the public authorities to the forestry problem principally from the side of the executive and administrative branch of government. We have discussed the government as a forest owner, and seen that it may manage such property in the manner of private parties, for the purpose of gaining a profit, and by the income the treasury obtains from this source lighten the burden of the taxpayers. We have also learned that the question of making a profit on the investment may be left in the background, and the government be willing to own and manage forests although for one reason or the other a profit cannot be expected, and the forest is a source of expense rather than revenue. This may be either because the authorities feel that without government management a permanent supply of raw material for the various industries cannot be depended upon; or the burden is undertaken because otherwise forests which are necessary to protect the water supply of rivers or irrigation works would be in danger of destruction. We have mentioned how municipalities could serve their interests if they acquired the possession of forest tracts as recreation grounds for their own people and summer visitors. We have also spoken of the duty of government in acquiring and disseminating knowledge regarding all matters pertaining to forestry.

But aside from such executive and administrative functions, the action of government is of the utmost

importance by the laws it may make, and which through their intentional or unforeseen action may exert the greatest influence upon the forestry of the country. To be sure, legislation is not all-powerful in this any more than in other spheres. It cannot create a forest industry where the natural and economic conditions do not favor it. No legislative fiat can produce a forest where nature disapproves. But it can to a great extent create favorable economic conditions, for the maintenance and rational exploitation of forests. By legislation we can on the one hand protect ourselves against the greed of private interests, which look exclusively towards the immediate profit, heedless of the rights of future generations. We can also protect our woodland owners and lumbermen from injuries done to them and their business by the recklessness and uncontrolled self-interest of others. Legislation can not only do these things, but it is our duty as a people to see that they are done. More than that, by unwise legislation we may impose upon forest exploiters such burdens that their business becomes unprofitable if carried on with a view to the greatest advantage of both the owners and the community, while, on the other hand, legislation may create conditions by which the interests of the forest exploiters and the people are brought into harmony. Considering all this, we may well come to the conclusion that the legislative relations of government to the forestry problem are even more important than its executive or administrative action, and it is

worth while to devote some separate chapters to forest legislation. In those chapters we will treat, in addition to a number of minor subjects, the questions of fire protection and taxation of forests. These two questions, the reader remembers, afford a solution to the problem why the lumbermen and other owners of cut-over timber-lands do not reforest their holdings; and we will see that the way to deal with these questions is by proper legislation.

CHAPTER IX

FIGHTING FIRES AND THIEVES

IN the cultivated forests of Europe, fires are rare events and, if they do break out, cause comparatively little damage. In British India, forest fires used to be as destructive as they are in North America. But since the government, through the administrative genius of Sir Diedrich Brandis, has taken the work of rational forest management in hand, they have practically ceased in all districts to which the work of the forester has extended. These examples show that forests, even where they are situated in the midst of dense settlements and are constantly being lumbered over, are not necessarily subject to great danger of fire. But they show by no means that the salvation of American forests lies in an adoption of the protective measures relied on by these foreign countries. Differences arising out of natural, economic, and political conditions make it necessary for us to work out our own salvation in this, as in most other problems that confront our national life.

Readers will remember that in an earlier chapter we emphasized the fact that practically every forest fire is the result of human carelessness. This

means that they are first kindled for legitimate purposes, but afterwards abandoned and left to go out or spread as accidental conditions favor. In the term "legitimate purposes" we must here include even such uses of fire in the woods as are in themselves injurious, but are excused by the necessities of making some use of the forest while economic conditions are such that more profitable forms of management are not available. In this category belongs, for instance, the burning up of valuable logs by settlers in clearing their lands, because they can find no market for them on account of lacking transportation facilities. The burning of underbrush to improve the pasture may also be sometimes excused on the ground that pasture is the best use the land can be put to. This practice, the results of which have already been dwelt upon, is but too prevalent in portions of the Appalachian region, where most of the mountain farmers are miserably poor, ignorant, and shiftless. It is the condition of the people in this section rather than the economic circumstances which makes this wastefulness apparently necessary. The firing of underbrush to improve the pasture is also indulged in to some extent by the owners of the great flocks of sheep in the far West. These people have much less excuse for doing so than the poor mountaineers of Tennessee and North Carolina. Their business is at best one of the worst causes of forest destruction, and their immense herds, scattering, as they do, over hundreds of square miles to bite off every vestige

of young sprouts and seedlings and trampling down what they cannot devour, have not inaptly been called "hoofed locusts." If to the injury done by the feet and teeth of the sheep is added the damage by fires set for their exclusive benefit, we can hardly continue to speak of a "legitimate" industry.

Occasionally it happens that a fire is set maliciously, with the express purpose of doing injury to a body of timber. This, however, is rare in America. The motive is usually lacking. In some parts of the world the country people living in the neighborhood of forests are inimical to the owners, because a rational forest management interferes with their imagined right to make use of other people's property, and this hostility every now and then leads to incendiarism. In India, popular superstitions sometimes lead to the same crime, as where a fine forest in the Himalayas was destroyed by village people as an offering to the spirit of smallpox that was ravaging the community. Motives of either kind are unknown in this country. But it is suspected by lumbermen, once in a while, that some person has fired a body of timber which its owners intended to let grow for a while longer, in order to compel the cutting of the half-killed trees to save them from destruction by fungi and insects. The motive of the miscreant in such cases is supposed to be the hope of getting the contract for logging the timber. How well founded such stories are I do not know. As far as I am aware,

no such crime was ever brought home to anybody in a legal proceeding.

The means which European foresters employ to protect the property under their care against fire are chiefly the following: in the first place, every forest is penetrated, in addition to the main roads, by a network of open lanes, so-called "fire-rides." These are kept bare, not merely of trees and underbrush, but also, as far as possible, of the ranker vegetation of grass and herbage, and especially all dry and inflammable debris. If a fire gets a start, it will soon come to one of these rides, where it is easily checked. One not familiar with the ways of forest fires is likely to be surprised at the idea that comparatively narrow roads and lanes can check conflagrations which, at other times, destroy whole forests and villages. But they must remember what was said above, that by far the greatest number of forest fires are not so-called top fires, which envelop large trees with flame and spread from crown to crown. They are generally surface fires, that merely consume the dry litter, dead branches, withered grass, and such stuff on the forest floor. The moment such fires come to a bare earth road, or even to a lane covered with sparse, short, and little inflammable vegetation, they stop for want of fuel. After a fire has once attained great dimensions, and especially where it has developed into a top fire, roads and lanes are no longer of the least benefit. For great fires, by sending currents of hot air upward, create strong winds by the inrush

of air to fill the space emptied by the vertical currents. These winds in turn carry the flames forward, so that they easily leap over roads, and even pretty broad watercourses. The object of fire protection must always be to prevent the blaze, when it has once broken out, from gaining such dimensions that it becomes uncontrollable. The beginning is always small, and easily managed.

Next to the system of roads and lanes comes a careful policing of the forest. If there is somebody whose business it is to see that no fire gets a start, there is practically no danger of appreciable damage being done. There is no reason, of course, why the watchman should not combine with his duties of fire-guard more or less of the other work of the many kinds constantly to be done in a well-kept forest, so that the expense of maintaining a guard becomes very insignificant. In fact, every person employed in or about a forest naturally becomes a fire-guard as soon as it is once understood that fires must not be allowed to smoulder. It is quite possible for one man sufficiently to police a forest three thousand and more acres in extent. Forest fires rarely spread rapidly at the beginning. They may smoulder even for days and weeks without extending over more than a few square feet of ground, waiting to be fanned into a blaze by a livelier wind. During all this time they make their presence known by clouds of blue, pungent smoke that cannot fail to strike the guard's eyes and nostrils.

Effective as these means of fire protection have proven to be, they are evidently applicable to our conditions to a limited extent only. They presuppose a cultivated forest where roads and rides either exist already or can be built without an expense greater than the business can bear. Most of our large forests are remote from the densely settled districts; they extend over areas immensely larger than even the greatest forests of Central Europe; and hardly an acre of it has been subject to silvicultural operations. Roads are few, and before a network of roads and lanes can come into existence, many decades will elapse. Clearly, then, if we are to have fire protection, we must for some time to come get it in a different manner from that prevailing in Europe.

It may be stated right here that the available means of protection here proposed, and which are in partially successful operation in several States, will not, even if employed to their fullest possible extent, do away with forest fires entirely. That result can be obtained by no means other than those adopted in Europe. But it is possible to very materially reduce the damage done by the flames, and to reduce the number of fires a great many times. This is something worth doing, especially as every step in that direction will bring us nearer to the conditions under which the more perfect system is possible.

To let the reader understand this matter clearly, I must again dwell upon the point that all fires can

easily be put out when they first start. All effort must therefore tend towards a speedy detection of the incipient blazes. How can this be done?

First of all there should be somebody in every forest neighborhood whose express business it is to be on the lookout for fires. To leave this duty to the chance action of volunteers is to leave it undone. On large, compact tracts of land this duty would naturally be attended to by the owners, who would soon enough find it profitable to maintain their own fire police, but, unfortunately, large, continuous tracts of timber-land owned by the same parties are rare; and here we come to another condition which is an obstacle in the way of forestry reform in this country.

Ever since the beginning of the federal government it has been its laudable aim to prevent the rise of a class of large land-owners tilling their holdings either by gangs of hired laborers or through the help of dependent tenants. It was rightly judged that a continuance of a large and influential class of yeomen farmers, such as existed at the time of the Revolution in New England and the middle States, was essential to the stability of democratic institutions. With this object in view the method of disposing of the public lands was from time to time amended. The recognition of squatters' rights, the pre-emption and homestead laws, all tended to restrict the acquisition of public lands to parcels of a few acres by each individual, so that the normal size of an American land-owner's

possession is now the "quarter-section," or one hundred and sixty acres. When large portions of the public domain were granted in aid of railroad building, still the same object was sought to be attained by giving to the beneficiaries of these grants alternate sections only. In pursuing this policy the government took it for granted that persons taking up public lands did so for the purpose of establishing farms thereon. Not until the dividing up of the government lands reached the arid and mountainous regions of the far West did it become evident that all of the public domain could not be treated in the same manner. Then a distinction was made between agricultural, mineral, and desert lands, and the last two classes were subjected to different rules from the first.

The settlement of the older western States had in the meantime progressed rapidly. In the eastern half of this section, within the forest zone proper and overlapping on the intermediate or wooded-prairie zone, there were large tracts which we may, for brevity's sake, call the "pine barrens," although not all of it is barren, nor was all of it ever covered with pine. These tracts, some of them very extensive, were really little adapted to agriculture, being mostly sandy or so hilly and broken that farming is rendered difficult. They are the natural forest reserves of the middle western country, and here it was and is that most of the lumbering operations of the Northwest were and

are now carried on. But, unfortunately, during the period when the settlement of this section was going forward most actively hardly anybody in this country had yet thought of the advisability of reserving a portion of the land for forests. So it came about that the really non-agricultural lands of this section were divided up in the same checkerboard fashion as the farming lands proper. Even now, a party buying timber-lands buys so many "forties," which may or may not be contiguous, but are rarely so for more than a few sections at a time. More often, one's purchase consists of quarter-sections contiguous at the corners only, which is almost as inconvenient as if they did not touch at all. The intervening tracts may belong to some other lumber concern, or they may be still public, or they may be held by settlers. For although the tracts we now have in mind are not really fit for any sort of agriculture, there are many reasons which prompt settlers to occupy them. Often the latter are "homesteaders" who take up a quarter-section of pine land, make a pretence of improving it and, when after five years they have received their patent, sell the timber. Not rarely these alleged settlers are really the hired "dummies" of the lumber companies. Again, much of this kind of land is sold by unscrupulous speculators, after the merchantable timber has been taken off, to immigrants from foreign countries or people from the cities who are without previous knowledge of farming and often buy

without having ever seen the land. What attracts these people is the apparently low price for which these lands can be had, but in reality even one or two dollars an acre is far too much to pay if the land is to be used for farming. For a year or two the new settler gets a fair crop, because the humus accumulated during the standing of the forest nourishes the plants. But very soon this is exhausted, and then the most that can be done is to raise a few potatoes and other sand-loving crops in the depressions of the soil, where the wash from the sides makes the latter a little more fertile. Probably by an elaborate application of fertilizers these lands could be rendered fairly productive, but the settlers have neither the means nor the skill to do this. Most of them, after a few years of struggle, either abandon their ill-chosen homesteads or if they stay resign themselves to a hopeless poverty. This and the demoralization consequent upon such conditions make such people an exceedingly undesirable element in any community.

The conditions here described apply in the first place to the lumber districts of the Lake region, especially to the States of Michigan, Wisconsin, and Minnesota. But with slight local variations they are also found in much of the southern forest zone between the Appalachians and the western plains. It is easily apparent that this scattered manner of holding timber-lands makes the proper policing of their holdings by the owners themselves exceedingly difficult and costly. Such policing is necessary

not only for protection against fire but also against timber thieves.

Timber stealing is a practice exceedingly common in all districts of the United States where lumbering is carried on on a large scale. Although many of the States have statutes making the cutting and carrying away of timber from other people's land larceny instead of mere trespass, a conviction or even prosecution for such an offence is practically unknown. For a conviction requires proof of malicious intent, and it is so easy to persuade the jury that there was merely a mistake, when there are, in the primeval wilderness, no boundary marks except, at best, the section lines blazed by the government surveyors many years ago. Even the most reputable lumbermen occasionally indulge in this little pastime, taking their chances of being caught at it, and having to pay to the owners what the stolen material is worth. The greatest sufferers from these depredations are the governments, both state and federal, whose lands are usually less well guarded than private holdings. Besides, many otherwise fairly honest people have no scruple about robbing or defrauding the government. In the remote and sparsely settled lumbering regions of the West, the stealing of government timber has at times reached incredible proportions. It has often happened that a sawmill has been set up in the midst of government forests and operated without even an attempt at concealment. Where such depredations were committed by the inhabitants

of the region, they might be to some extent excused because these men were still imbued with the backwoodsman's notion of the early days, that public property is the property of nobody. But no such extenuation exists for the great corporations owned and managed by wealthy people of the East, who deliberately engaged in this business; although perhaps this thievery is no more dishonest than other practices of people whose only notion of commercial honesty is to keep one's banker good-natured.

For a long time the federal government made no attempt to check these ravages in its forests. The first step in the right direction was taken under the presidency of Mr. Hayes, when Carl Schurz, as Secretary of the Interior, vigorously prosecuted some of the trespassers. For this display of integrity and energy he was bitterly attacked in Congress, no less a person than James G. Blaine leading the onslaught. That distinguished statesman showed on this occasion a narrowness and shortsightedness little to his credit by trying to ridicule the Secretary as one unable to appreciate the greatness of this country and attempting to apply to its inexhaustible resources the methods of little Prussia. Since that time the supervision of the government has gradually been improved until now comparatively little trespassing is committed. Those States also which are possessed of timber-lands have mostly established a timber police of greater or less efficiency; but the agents

intrusted with these duties are usually concerned more about recovering the value of timber already cut than to prevent trespasses. As the scattered system of ownership practically prevents an effective fire police by private holders of timber-land, it is necessary that this duty be undertaken by government. This position may be maintained on two grounds: that the owners of forest property are entitled to protection against a common danger from which they cannot protect themselves; and that the entire people are interested in having this kind of property preserved from destruction. On whichever ground you put it, the duty of government in this matter is admitted practically by everybody. The question is, how can this duty be best performed?

The easiest, but also the least effective, way of doing so is the passage of penal statutes. Probably every State, as well as the United States, has had laws of this kind for a long time. Their provisions differ as to details in the various jurisdictions, but usually they threaten with fine and imprisonment any person convicted of setting fire on any land not his own and failing to extinguish it before leaving. This refers, of course, to fires kindled for purposes in themselves legitimate. Malicious incendiarism is dealt with in a more severe manner. The difficulty with laws of this kind lies in their enforcement. Fires in the woods are so common as not in themselves to attract much notice or apprehension. They may be left

burning by campers miles away from any human habitation, and how can evidence against the perpetrators possibly be obtained? Even where direct or circumstantial evidence could be had, if the people of the vicinity were willing to testify, witnesses are extremely reluctant to go on the witness stand for fear of incurring the enmity of their neighbors. Then, also, who is there to begin the prosecution? The state's attorney is at the county seat, perhaps many miles away, and cannot act unless a complaint is made to him; and who will go out of his way to make such complaint, purely for the public good and with much inconvenience and possible injury to himself? To cause people to make complaints the statutes often promise to the informer a portion of the fine collected from the offender. But the very fact that the complaining witness is pecuniarily interested in the success of the prosecution discredits him in the eyes of court and jury and makes a conviction more difficult. So it may be said that penal statutes against negligence in the handling of fire are of themselves ineffectual and usually mere dead letters.

A step forward is taken where it is made the express duty of constables and other rural officials to enforce the fire laws. Although the compensation of such officers is usually derived from the fees and costs collected with the fine imposed on offenders, yet as the constable is merely doing his official duty there is no such stigma attaching to his acts as keeps private parties from becoming informers

for a reward. The constables are often fairly zealous in enforcing the law against tramps and non-residents, but rarely so against the settlers, who may be the worst offenders, but on whom, as voters, the constable is dependent for re-election. Besides, the constable will be able to obtain evidence in but a very few cases of negligent firing, especially as in the thinly settled forest regions his district often embraces a very large territory. Some States have within the last few years authorized the local authorities in their discretion to prohibit the setting of fires for clearing and other purposes during the driest and most dangerous season of the year. If the local officials took care to avail themselves of such authority it ought to help materially to reduce the number of destructive fires, but, unfortunately, such prohibitory measures are rarely adopted. The local authorities are often either too unintelligent to appreciate their necessity or afraid of running counter to the wishes of influential voters. Sometimes the setting of fires for "burning brush" is not permitted at all except with the license and under the supervision of some official. This is an excellent plan, but suffers from the same danger of not being enforced in a community where public opinion is apathetic or hostile with regard to such precautions.

While all these legal provisions are good as far as they go, the only effective means of forest-fire police lies in the direction of a system of specially appointed fire wardens, subject to due supervision

by some central authority. Such a system is now in fairly successful operation in the States of New York and Minnesota, and to a certain extent in Wisconsin and a few other States.

The principle of this system is simply to have, throughout the forest districts, as large a number of persons as expedient chosen from among the residents of each locality, whose special duty is to see that the fire laws are enforced, and especially that every fire burning unguarded in the woods is at once detected and put out before it attains perilous dimensions. For this purpose these fire wardens are empowered to call upon the people of their districts to assist in putting out fires, and provision is made for the compensation of the wardens and their helpers for work actually done by them. The local fire wardens ought to be appointed and be subject to the supervision of a central authority at the seat of the state government, in order to render them, at least in some degree, independent of the voters in their own locality. For efficient service need never be expected, where the warden is dependent on a local public opinion that is apt to consider his work as officious interference and extravagant burdening of the taxpayers. Being appointed by a superior officer removed from such influences, the local warden will also be more amenable to control and can be removed if he turns out incompetent or inefficient. The superintendent ought to be enabled to become personally acquainted with each warden, and visit each from time to time, and at

unexpected periods, to learn the manner in which he performs his duties.

With a system of this kind there is, of course, some expense connected, and this is usually urged as a principal reason against its adoption. Penny-wisdom and pound-foolishness is the rule with the "taxpayer" in this as in most other things, while nothing is more popular with politicians anxious to capture votes than to cry out against alleged waste-fulness in public expenditure. This obstacle, like all others growing out of ignorance, selfishness, and laziness, can be overcome by persistence and the logic of facts. In those States where the plan has been tried it has done incalculable good; it must gradually be perfected in its details, and I doubt not will, within a reasonable time, be introduced in all States to the conditions of which it is applicable. The question of who is to bear the expense will probably be solved by making both the localities in which the work is done and the State as a whole participate in the burden. This seems obviously just, for the localities where life and property are in immediate danger derive the most benefit, while the entire State is likewise deeply interested in for-est protection. To make the localities bear the entire burden would also be impracticable for the further reason that the financial capacity of these remote and thinly populated districts is apt to be very small.

It ought to be stated here that in the Dominion of Canada a different system of fire protection has

been introduced which promises to bear good results, but which is made possible by the different policy pursued by our northern neighbors with regard to their public lands. In the province of Ontario, where the most valuable forests of Canada are found, the pine lands belonging to the crown are not sold, as they are in the States, but lumbermen are given the privilege of cutting the merchantable timber under the supervision of government officials. They are bound by their contracts, among other things, to employ guards on the lands turned over to them, and to take various other precautions against fire.

A provision which has been enacted by law in some States, and which some lumbermen follow voluntarily, is to burn up, under proper precautions, the debris left on the ground after felling. It is universally admitted that these piles of tree tops and branches, lying loosely and quickly drying, are among the most dangerous places in the woods. Not a few destructive fires are traced to them annually. It has been demonstrated that the expense of properly burning these remnants is so low that even where the margin of profit is very small, a lumberman can well afford to take this precaution, and any failure to do so must be ascribed to wanton disregard of the rights of others.

The various laws designed to lessen the danger of forest fires, and which we have briefly outlined above, cannot fail, if faithfully enforced, to do considerable good. But under our form of

government there is no chance of their being faithfully executed unless public opinion upholds them. The whole problem, therefore, resolves itself at last, like all similar problems in the United States, into the question: how can the public be brought to demand, persistently and emphatically, due care in the handling of fire in the woods by all parties concerned, and the punishment of all persons guilty of negligence?

The enforcement of the law itself undoubtedly exerts a very great educational influence on the people. A single conviction for negligent handling of fire, or even a prosecution that fails for insufficient evidence, will make all the people of the neighborhood more careful for a while at least. Not only will they be afraid of punishment, but the arrest and trial of an offender will forcibly call attention to the necessity of care in a manner which no amount of writing and speaking can accomplish. Yet writing and speaking will do much in this direction. The local and agricultural press, which reaches the persons here concerned far more often than the city daily or the literary magazine, has a duty here to which it pays far too little attention. The rural preachers also ought to make this vice of negligent fire setting a frequent topic of their sermons. For here certainly is a question of morals, and a sin of which their parishioners in the forest districts are guilty much oftener than of some others, which are favorite topics of the ministers. At the bottom of the whole matter is a lack of the

sense of obligation not to injure others ; an absence of a feeling of responsibility for one's own acts. A man who allows a fire kindled on his own land to destroy the property of another certainly does as great a wrong to his neighbor as if he broke open his money-drawer and stole its contents. Or again, one who by his negligence causes forest fires which he knows, or ought to know, are one of the gravest sources of injury to the nation, is as little a patriot as one who would refuse to stand by his country's flag in times of foreign aggression.

It might be said that great reforms in this country require a generation to become perfectly established. For the people who are too old to change their intellectual habits must be replaced by a younger element who from childhood have been trained in the right direction. This is true of forest fires and the forest problem in general, as well as of any other great national question. It is essential, therefore, that right moral principles regarding this matter and a correct mental attitude in reference to the forest be instilled in our youth. Much well-intentioned nonsense has been spoken and written about the duty of our schools in connection with the forestry problem. Some enthusiasts have even advocated that the children in the common schools be taught to plant and care for trees, as a means of helping to solve the question. It is certainly desirable that every farmer's boy should learn the elements of arboriculture, but why should the lesson be taught in the public school,

any more than how to plow or milk the cows? As for forestry, readers of this book I trust realize by this time that planting shade trees along roads or ornamental trees on lawns is something entirely different from forestry. Farmers ought to learn how to treat their timber-lots, better than they now usually do, and on the western plains, where there are no natural timber-lots, they should be encouraged to plant them. This they must learn as they learn other agricultural operations, but no good can come from talking to the children at the district school about such things instead of teaching them the "three Rs." I am sure that every sane forester will agree to this. But on the other hand it is eminently proper for rural teachers, in the localities where forest fires are a constant menace, to impress on their pupils by precept, instruction, and example the duty of being careful about fire in the woods. This is not instruction in forestry, but simply a part of that moral influence a good teacher is expected to exert upon the children under his or her care. It is natural in such places to dwell particularly on the matter of negligence with fires, because that is one of the most prevalent vices there, just as in cities a teacher would naturally lay most stress on the moral offences to which children in such localities are likely to be most given.

Not a little educational influence is likewise exerted, I have no doubt, by the practice adopted in many localities of late of placing sign-boards in exposed places warning people to be careful.

Anything which tends to keep constantly before the people of the forest districts the necessity of the greatest care in the setting and guarding of fires in the woods is desirable as a means of creating such a change of public opinion that negligence will cease to be considered as something venial, but be looked upon universally as what it really is,—a heinous crime deserving the abhorrence of all decent people. As soon as such a condition of public opinion has been gained there will be no further difficulty in enforcing the fire-police laws of all kinds, and the very success of such laws will gradually make them unnecessary and permit the lightening of the burden which for a time must be imposed upon the taxpayers. The disappearance of forest fires as the regular and ordinary occurrence wherever lumbering has been carried on will mark the time when lumbermen will be ready to shape their business with a view to reforesting the denuded tracts. It will not be necessary to wait until fires have become as rare as they are in Germany. The lumbermen will be ready to take some chances, but the probability that the young timber will reach maturity must at least be greater than that it will be killed by fire before it becomes merchantable.

With the restocking of cut-over areas by silvicultural operations will come a more conservative manner of lumbering in the remnants of the natural forest. We have had several occasions to refer to the fact that lumbermen often cut the trees long before they have reached the size when their taking

would be most profitable. This is especially true of recent years. Formerly, when competition was less sharp and the margin of profits wider, while on the other hand the abundance of material made it possible to log in those places only where the cost of transportation was lowest, it was common to cull only the largest and best trees. The rest were left standing, to be taken twenty or thirty years later, when the quantity of lumber harvested from them was, of course, much greater. But nowadays logging has been carried to localities that are comparatively inaccessible, and in order to overcome the greater cost it is necessary to take the greatest possible amount of material from each tract. So trees are cut of all sizes, down to the mere pole of seven inches in diameter. Moreover, the lumberman knows by experience that if he lets the young tree grow, he runs the chance that it will he destroyed by the fire long before he comes around a second time to cut it. With the latter danger lessened, he will much oftener prefer to leave the sapling till it has increased and improved the character of its wood. It is not rarely proposed to prohibit by law the cutting of pine trees less than twelve inches in diameter or the sale of logs of such size. A law of this kind, even if it were constitutional and enforceable, would be unwise. For as long as the young trees left on the slashings will probably be destroyed by fire, it is better to make use of them such as they are. In Ontario, where lumbermen buy the privilege of logging on crown

lands, they must leave the saplings; but there at least an effort is made to prevent the fires.

Another step towards conservative lumbering, which is likely to be taken when the fires diminish in frequency, is that of preserving the young growth from injury in felling. At present nothing is further from the minds of logging crews. Where a tree standing in the midst of a number of young ones is cut a certain amount of injury to the latter is rarely avoidable. But it is not necessary, as is done now, to let the oxen and horses trample down the seedlings, to roll logs upon them, to let skids and sleds run over them, and where a sapling is an inch in the way to chop it down. All this is the every-day practice of American lumber crews everywhere. In the few places in the United States where silviculture has been attempted, as in Biltmore forest, one of the first things the forester has had to teach his men has been to take heed of the young trees. But as soon as lumbermen generally discover that the fire is likely to keep out of their slashings, this lesson will be speedily learned.

All this, and much more in the future of American forests, depends upon the restriction of fires. We have seen in this chapter that a proper fire police cannot, as a rule, be kept up by the owners of timber-lands themselves, owing to the scattered manner in which their holdings are ordinarily situated. We have learned that government must intervene by proper legislation to protect the forests, just as governmental agencies protect city

property against fire. We have discussed some of the means by which the various States have attempted to perform this duty, and the manner in which such laws are working; and finally we have come to the conclusion that after all the best hope for us lies in education and the creating of a public opinion that will emphatically condemn the reckless incendiary. But we have intimated above that there is another factor depending on legislation which must be adjusted before forestry based on silviculture can pay in the United States. This matter of taxation will be the subject of the next chapter.

CHAPTER X

FORESTRY AND TAXATION

THE problem of raising taxes in such manner as to make every citizen bear his just share of the public expense and at the same time be as little as possible a burden on the industries of the people is admittedly one of the most difficult ones confronting modern statesmanship. It might be said that taxes are always paid grudgingly, little credit though this fact may reflect upon our people. The chronic grumbler, the tax-fighter and perjured tax-dodger, is a well-known nuisance in every community, and usually belongs to that section of the people arrogating to itself the name of "the better class." With all this dissatisfaction created by tax laws in every State, it is remarkable that comparatively little study has been devoted in this country to this subject, and that most of our taxes, especially those for local expenditures, are still levied by a system which is almost barbarous in its crudeness, inefficiency, and injustice.

As everybody knows, most of the taxes raised in the United States for municipal and local expenditure of all kinds, and to a considerable extent for the cost of the state governments, is laid upon

property, real and personal, at a more or less arbitrary valuation. The defects of this system are pretty well understood. No regard is paid to the question whether the property does or does not produce a revenue, so as to often make it impossible to hold property which for one reason or the other does not furnish an annual income. In other cases, again, the whole revenue is eaten up by the taxes, making it as undesirable to hold such property as it is to own such as produces no income whatever. The fact that practically the greater portion of personal property is exempt from taxation altogether, because the assessors cannot discover it, makes the injustice of the burden on the real property still more glaring.

No species of property is hit more hardly by the crudities of the tax laws than timber-lands. This circumstance is brought about by a number of conditions, and it exists as well in regard to lands stocked with merchantable timber as to lands covered with young growth. The question of making the forest industries of all kinds bear their just share of public expenditures is, of course, intimately bound up with the whole problem of taxation, and cannot be fully discussed in this book. So much only we will try to present here as is necessary to show how a faulty method of taxation is one of the chief obstacles to the introduction of better systems of forest exploitation, and especially to the restocking of denuded timber areas by silvicultural treatment.

It must be clear from the outset that the necessity of paying annually a certain percentage of the value of a piece of forest land during the long period when the young trees slowly grow towards maturity must be a heavy burden upon the owners. Still, if this annual payment were kept within reasonable limits, it might be borne. It would be simply one of the items of expenditure which are required during this interval, just like those for interest, labor, supervision, and other things. If there is a fair expectation that the final harvest will net an amount of money sufficient to reimburse the proprietor for all these expenses with compound interest, the owner of timber-lands has no particular grievance. But, unfortunately, the amount so payable every year is usually far too high to permit a hope that it could ever be made up by the final return, even if the danger from fire did not make the raising of a new forest to maturity precarious. The reason why the annual payment is so high must be sought on the one hand in faulty assessment, on the other in extravagant expenditures.

The author ought to state in this place that in the discussion of the taxing problem he has in view primarily the laws and practice prevailing in the State of Wisconsin, with which he is most familiar. But the differences existing in the various other States are small and do not radically affect the understanding of the question how taxes affect the conduct of forestry in the United States.

The assessment of timber-lands, like all other property, is usually left to an officer or board selected from among the residents of the town or other civil subdivision in which the property is situated. In the cities these officials are sometimes real experts in matters of taxation, but far oftener, and always in the rural districts where forests are found, they have no special knowledge of the subject and are guided merely by such practical information as they possess in common with all other farmers and business men of the neighborhood. Like most of our laws and their execution, assessments are based on the assumption that all lands are held by their owners either as city lots or as farms, present or prospective. When the assessor finds a tract of land stocked with growing timber, he proceeds to assess its value as he would that of a piece of farm land. He ascertains the price at which a piece of similar land would likely be bought by an intending agricultural settler. Let us say that the usual price paid in the neighborhood for an acre of wild land fitted for agriculture is five dollars; probably the assessor, intending to be fair, and recognizing that the land in question is inferior in soil and remote as to location, reduces the price to three dollars. The assessment is usually made at about two thirds of the real value, so that the tract goes down in the assessment roll at two dollars. Let us say that the tax levied, for all purposes, amounts to five per cent. of the assessed valuation. This may seem exorbitant, but is rather low as levies are

made in the forest counties of Wisconsin. It is evident that, in a case like this, the taxes would in thirty years equal the value of the property, not counting the interest. This is assuming that the assessment is a fair one according to the standard employed. But it rarely is; and there is another feature of the problem.

Timber-lands are usually owned by non-residents, often by corporations, the stockholders of which are non-residents. This means that their owners have no direct influence on the election of assessors, and cannot defend themselves against over-valuation by defeating the re-election of an unjust officer. On the other hand the residents are directly benefited by unjust treatment of the non-residents, and therefore not likely to be particularly put out by such injustice. The result of this is naturally that timber-lands are often over-assessed, even according to the standard used for agricultural lands, which is of itself unfair. If such over-assessment is glaringly conspicuous, the courts will, of course, afford relief. But where it is moderate, though in the aggregate it may amount to a great sum, the victims would rather pay than go to the expense and annoyance of litigation. All this is assuming that the assessor is honest. But, unfortunately, that assumption does not always hold true. Not rarely the assessor simply blackmails the timber owner by threatening to put an outrageous valuation on his land, in the hope of being bought off. Too often that hope is realized, although the owner

must know that if he pays once he will surely be fleeced again the next year. The result of all these abuses is that a very large proportion of forest lands all over the country are abandoned by their owners after the merchantable timber has been removed. The taxes are no longer paid; at the tax sales no bidders are found, and after due time the title vests in the county or State, according to the statutes in force in the different jurisdictions. These abandoned woodlands might form the nucleus of a fine system of state forests, if the governments were ready to undertake their care. In fact, a few States are beginning to avail themselves of the opportunity. But at the same time, it cannot be denied that the whole procedure is nothing but confiscation under the guise of taxation. In most cases the counties or other governmental agencies which obtain the tax titles are anxious to sell the lands again, and now it becomes apparent how utterly unjust the assessment was, for lands that were taxed on the basis of one or two dollars assessed valuation an acre are often sold to speculators at the rate of ten or twelve dollars a "forty."

This may be a convenient place to indicate roughly how the value of woodlands is computed in Europe, although it must be understood that this method is not applicable to our country under present conditions, and is not suggested as a substitute for prevailing standards of assessment. In this country a person buying timber-lands considers the value of the merchantable timber only. The young

trees, seedlings and saplings, are disregarded altogether. It stands to reason, however, that if a forest ripe for the axe has a certain value, a forest that will become merchantable thirty or fifty years from now must have a value likewise. It can be found by taking the value the forest will have at maturity and deduct therefrom what it will cost in interest and running expenses to bring it to that stage. In the technical language of foresters, the amount so computed is called by the rather cumbersome term "expectation value." To make this calculation it is necessary, of course, to have the means of telling how much lumber the forest will yield at maturity. This the European forester can approximately ascertain by means of those yield tables mentioned in a former chapter. But the American timber buyer has no means of computing the amount of timber his young forest will yield many years hence, because yield tables have never been constructed nor the observations made on which they could be based. Moreover, the ever-present factor of fire renders a computation of expectation values impossible with us. In Europe the possibility that young timber will be destroyed before it becomes merchantable is so small that it may be disregarded. In the United States more or less injury from fire is almost certain, and the probability of total destruction, with coniferous forests at least, is greater than that it will escape.

If cut-over timber-lands are to be assessed for taxes in such a manner as to do no injustice to the

owner, the assessment must be based, not upon what a man would be willing to pay who wanted the land for agriculture, but on what timber producers would pay for it. That this is not possible under present conditions is plain. The only fair thing to do, then, would be to assess such lands at what the counties will get when they sell their tax titles,—in other words, a few cents an acre. This, however, the local assessors refuse to do, and the confiscation goes merrily on.

So far we have spoken of the cases where lands from which the merchantable timber has been taken are assessed and taxed at an exorbitant rate. But timber owners fare not a whit better when they are taxed on land stocked with uncut merchantable timber. It is remarkable how much sound, merchantable pine or other timber the assessor is able to find on a given tract of land. It must be said, however, that it is equally wonderful how little of it can be found by the estimator who looks at it in the employ of a prospective purchaser. The fact is that all information obtainable as to the amount of merchantable timber now growing on the forest lands of the country is utterly unreliable. The estimates are based on guess-work at best, and the guesses are affected by the purposes for which they are made. It is probable that the information really in the possession of the great lumbering concerns and their woodsmen is much more accurate than the statements that are made by them to strangers, including takers of the census and other

official inquirers. There are numerous reasons why it is not for the interest of owners to let others know too definitely the quantity of timber growing on their land. The fear of the tax collector is but one of these reasons; that of the business competitor is equally strong. The upshot of it all is, that woodsmen of equal skill and experience, and equal degrees of acquaintance with the particular locality, will differ widely in their estimates of the available timber resources. Even aside from intentional or unintentional bias, the methods of making estimates of standing timber are so crude and rough that nothing but a faint approximation of the real facts is ever obtained by them. Undoubtedly these results are sufficiently accurate for the business of lumbering as now conducted. But when lumbering shall be based in this country on a system of silviculture, the present methods of measuring and valuing wood crops will have to be replaced by others that give more accurate data.

The art of measuring wood crops, either felled or standing, has been highly developed in Europe. Foresters of a mathematical turn of mind have delighted in inventing various methods of mensuration, and reduced even the simplest things to mathematical formulas which make the handbooks of this art exceedingly hard reading to those not fond of dealing with equations. Various implements have been devised to assist in obtaining the data required for computation. The aim with Europeans invariably is to discover the volume of

wood contained in a forest as expressed in cubic metres. There can be no doubt that this in itself brings about much greater accuracy than our system of expressing quantity in feet board measure, although it is not so convenient for the lumberman, because he must first make another calculation before he can tell how many boards he ought to saw out of a given amount of logs. With the development of American silvicultural forestry, methods of mensuration adapted to American conditions and approaching those of Europe in accuracy will undoubtedly be invented. In fact, a very simple and convenient one has already been suggested in a recent bulletin of the United States Forestry Division. When such methods shall be in universal use, even the rural assessor will probably be prevailed upon to apply them. But one may hope that by that time a different way may have been found to let the forest and lumber interests bear their fair portion of the public burden.

We have stated that the owners of timber-lands are affected unjustly not only by the assessment of taxes, but also by the expenditure of the proceeds. The way in which lavish expenditure is more burdensome to them than to other taxpayers is the following. In the districts where the forests are situated, it very often happens that but a small proportion of the taxes levied is paid by residents. The timber-lands from which the greater portion of taxes is derived belong mostly to the non-resident lumbermen. The latter therefore have

no voice either in the levy of the tax or the manner of its expenditure. The report of the Wisconsin tax commissioners for 1898 shows, among other things, that in the town of Georgetown, Price County, during the preceding ten years the residents paid but 4.8 per cent. of the taxes levied. In many other towns a similar proportion prevailed. This in itself would be an almost irresistible temptation to extravagant expenditure on the part of the local authorities. It should be observed that in Wisconsin the township system prevails, and the town and school-district taxes are levied by the voters in town meeting assembled. But this is not the worst of the predicament in which the landowners find themselves. Not only do they pay the taxes which others impose, but practically not a penny of the large sums they pay into the public treasury is expended for their benefit, except perhaps so much of it as goes towards the support of the courts. The heaviest expenses in all these newly settled districts are, on the one hand, the establishing of schools, on the other, the building of roads and bridges. For the former the lumbermen obviously have no use, and the latter they do not get, for all improvements are made where the settlers live, and for their benefit, but not in the remote parts where the timber-lands lie. Of late the State of Wisconsin has made a beginning towards establishing a forest-fire police, but the expense which may be incurred for this purpose in every township of thirty-six sections is limited by

law to one hundred dollars a year, and as a matter of fact most towns pay far less than that, or nothing at all, towards this end. If it is true, as is often stated, that taxes are paid in return for the protection received from the government, then timber-lands ought not to be taxed at all, for they receive very little protection indeed against their deadly enemies, the fire and the man who sets it. That taxation in these new districts must be high is unavoidable, for all the public improvements which older regions need merely keep in repair must here be created out of nothing. But in justice the benefits ought to be extended to all property which shares in the burden. Much of the expense incurred is also due to mere want of business skill, looseness of methods, and sometimes to corruption. Money so squandered of course goes into the pockets of the residents, as officials and contractors, while most of it comes out of the treasury of the non-resident lumbermen, who on their part spend thousands of dollars in wages and for supplies to the very people who so unfairly bleed them.

The excessive burden of taxes resting upon the woodlands, both stocked and denuded, cannot fail to be a very serious hindrance to successful silvicultural forestry in all those States where methods similar to that described above prevail. But unfortunately the problem how those methods of taxation can be improved is very difficult of solution. A radical relief can be obtained by the forest interests

only in common with all other business interests of the country through the total abolition of the inadequate and unfair tax on property and the introduction of a more equitable scheme. But a number of plans have been proposed to remedy the evil where timber-lands are particularly the sufferers.

It is often suggested that owners of growing forests should be exempted from taxes thereon until the time of the final harvest. Usually the proposition includes the payment, at the time of the harvest, of a sum equal to what would ordinarily be paid in annual instalments. In this form I cannot see that the relief to the owner would be very great. He would be excused from paying anything if the crop should be destroyed before maturity. But aside from that, none of the difficulties would be removed. The unfair assessment and excessive expenditures would still continue, and the large sum to be paid at the harvest would probably doom the enterprise to financial failure. On the other hand, the local authorities would be seriously handicapped from the large annual deficiency in their receipts—a difficulty which could hardly be made good by the recovery of a very great lump sum in the distant future.

In Pennsylvania there is a law under which owners of not to exceed fifty acres, stocked with at least fifty trees of eight inches in diameter or over to the acre, may obtain a rebate of eighty per cent. of the tax annually imposed on such land. This law is clearly not designed to apply to forests managed

for lumber, but rather to timber-lots and parks where the trees are preserved as a protection to the climate and physiographic conditions. In fact, the preamble to the law intimates such an intention. It does not help us, therefore, to solve the difficulties we are discussing in regard to forestry as a business.

Sometimes it is proposed that persons planting and maintaining trees on their lands shall be exempt from taxes on them. This is, like the Pennsylvania plan, applicable rather to cases where forests should be preserved for reasons other than lumber production. It is particularly useful on the treeless plains, where farmers ought to be encouraged to plant timber belts. In effect it is a bounty on tree planting and suffers from many of the faults of the bounty system. It is difficult to prevent people from making a mere pretence of maintaining a growing forest, when in reality they are but trying to escape taxation on their pasture lands. The United States for a number of years offered a quarter section of land in the treeless section to any one who would undertake to plant a certain number of acres with trees and care for them; but the frauds growing out of this "tree-claim" law were so glaring, and the results in the way of establishing forests on the western plains were so small, that the law was repealed. There is danger that laws exempting tree plantations from taxes may have similar bad results. A total exemption of forest lands used for lumber production would, of course, be a radical cure of all evils growing out of taxation, and it is

sometimes proposed on the plea that public welfare demands such favors to the lumber interests. But the plea is not well founded. If silvicultural forestry cannot be made to pay without a bounty, whether in the shape of exemption from taxes or cash payments, it is very doubtful whether it could be made permanently profitable with such an artificial stimulus. In the meantime, the exemption would be invidious and subject to constant attacks. Forest owners would have to be "in politics" all the time, to protect their interests, and would soon rival the railways as intentional or unintentional promoters of corruption. No true friend of improved forestry ought to advocate such dangerous measures as this.

To the author it would seem as if the solution of the problem of taxing forests and lumber interests would lie in the direction of taxing them on their gross income instead of their property, in analogy to the manner in which transportation companies are taxed. Nearly all concerns which carry on lumbering and other forms of forest exploitation on a large scale in the United States are now legally organized as corporations. Very much of the timberlands of the country is owned by these same companies or by others organized for the purpose. If these corporations were relieved from property taxes and instead contributed a percentage of their gross receipts to the public expenses, it would be comparatively easy to adjust the amount payable with justice to all parties concerned. On the other

hand, the difficulties arising out of the assessment of lands by the local authorities would disappear. It is true that not all timber-lands held for lumbering on a large scale are owned by corporations. But if individual holders wish to avail themselves of the benefits of the law, they may easily organize corporations to take the title, while they retain a controlling interest in the stock. To make the law directly applicable to individuals would probably be impracticable, for the reason that individuals would ordinarily have other sources of income, and it might be impossible to separate the income arising out of their lumber interests from other revenues.

A system such as this would, in the author's opinion, solve the taxation question in a manner satisfactory to everybody. Until it has been introduced only palliatives are available, which must look principally in the direction of a fairer method of assessing woodlands, especially those from which the merchantable timber has been removed. These means lie partly with the courts. After a somewhat careful study of the authorities the author has come to the conclusion that it will be held, if the matter is brought before a court in proper shape, that an assessment of such lands based upon what agricultural lands will sell for, is of itself unfair and will be reduced. The legal reasons for this conclusion cannot, of course, be set forth in a volume like this. There is another feature of the taxation of forest products which, on account of the frequency with which it is discussed, deserves notice. That is the

question of import duties upon lumber. Nothing is heard more frequently than the contention that lumber ought to be admitted free, in order that the forests of the country might be protected from destruction by the lumbermen. With the general question of the wisdom of protective duties we have nothing to do in this book. But every forester will protest against the means of "protecting" the forests by destroying the lumber industry. That free admission of lumber would work a total or practical destruction of the lumber business is evidently assumed by those urging this argument, for otherwise the expected preservation of the forests could not result. We may therefore accept their conclusion that free trade in lumber would keep the axe away from the remaining merchantable timber. It must be plain to attentive readers that people who prefer this argument have not grasped the very first principle of forestry, which is the utilization of the forests while preserving their existence. Not to destroy the lumber industry, but to insure its continuation during the whole future life of the nation is the aim of forestry reform. To let forests lie idle, a useless wilderness, would not even preserve them, for fire, windfall, insects, and fungi would gradually destroy them. The conditions under which the primeval forests were created, flourished, and preserved themselves have gone forever. The forests of the future, if they are to exist at all, in the midst of dense population and a civilization in a great measure

depending on their products, must be skilfully and lovingly cared for by man. In return they will supply him with what he needs of their stock, and they will protect his hillsides and watercourses, and beckon him to their shades for rest and recreation more beneficently than ever the primeval wilderness did. It may or may not be true that sound policy demands free trade in lumber. But that is a question to be answered on general grounds of national economy. As a means of preserving the forests it must be repudiated by the advocates of forestry reform.

The forest and lumber interests must not and do not demand to be exempt from their due share in carrying the burden of taxation necessary to support our government, national, state, or local. What they do demand and are entitled to is such an adjustment of the manner and amount of taxation that on the one hand these forms of industry are made to pay no greater proportion of the taxes than other interests, and on the other hand the tax regulations do not make a rational conduct of the forestry business impossible. It is for the interest of the whole nation that this question be settled right. If the people only understood how seriously their interests are injured by the faulty manner of forest taxation, they would be far more clamorous than the lumbermen themselves to have these abuses rectified. For the lumbermen have paid their exorbitant taxes in the past and have made money, even built up great fortunes; and they do so now,

and may continue to do so until all the original stock of timber is exhausted. But they are doing this at the expense of the nation. While on the one hand the people fail to protect them against fire, on the other hand they extort excessive taxes. Thereby they make it impossible for lumbermen to cut their timber conservatively, with due attention to reforestation, and to carry on proper silviculture. The people alone are the losers.

On the treatment of the questions of fire and taxes depends the future of American forest industries. Their solution can be reached by nothing but legislation ; legislation depends upon the will of the people in a commonwealth where all political action is ultimately decided by public opinion. In other countries, the judgment of a few enlightened men may sometimes introduce wise reforms, even against the will of those who are to reap the ultimate benefit. But this incidental advantage of monarchy and aristocracy we gave up when we chose the greater benefits of a democratic form of national life. Having made the many their own masters, we must persuade them to do what will be for their own good, and point out to them the way they cannot find by themselves. This necessity of teaching not a few, but the many, makes reforms in our governmental affairs plants of slow growth, and the time which is spent in agitation and instruction is usually much longer with us than with other nations. The forestry problem is but just emerging from this preliminary stage. While it is not the

purpose of this book to furnish a history of the movement for forestry reform in this country, our survey of the subject would be incomplete if we did not devote a chapter to the various phases through which the movement has passed. At the same time we ought to consider some of the work which is done by various governmental and educational institutions, and the matter of agitation and instruction. Finally we must show how within quite recent years the movement has begun to have some results, both in legislation and actual silviculture.

CHAPTER XI

REFORM IN FORESTRY METHODS

IT would be impossible to fix the year when the agitation for better methods of treating forest resources in the United States began. In the writings of scientific men, as well as of travellers and lovers of scenery and outdoor life, of more than fifty years ago, one occasionally finds expressions of regret that our forests are being wasted. Gradually the number of such expressions increases. Writers begin to call attention to the evil effects deforestation must exercise on climate, waterflow, and fertility of soil. But for a very long time no practical remedies are suggested, nor is the question approached in a systematic and business-like manner.

It is a peculiar feature of the history of American forestry that the impetus towards reform began with botanists and other scientific men on the one hand, horticulturists and landscape gardeners on the other. It was far different in Europe, and especially Germany, when about the middle of the eighteenth century the need of a more rational treatment of forests first attracted wide-spread attention. There it was from an economic and financial standpoint that the question was first

approached. Many of the rulers of the multitude of small communities into which Germany was divided, and who treated their dominions very much as a man would his private estates, had rather expensive tastes, and found that they must either retrench or increase their revenues. When the ability of their subjects to pay taxes was exhausted, they turned to the large forests, which most of them possessed, in order to replenish their coffers, and their advisers usually had sense enough to see that one could increase the productivity of the forests without destroying them. When fifty years later most of these princelings were mediatized, the larger portion of their forests became the property of the greater states of which their territories were made parts, and formed the nucleus of the magnificent system of state forests Germany enjoys to-day. On the other hand, the abler statesmen of the eighteenth century saw that there was danger of the supply of lumber and fire-wood,—which latter was then of much more importance than now,—falling behind the demand and prices rising excessively. So they thought of ways to increase the productivity of forests and prevent their destruction. Thus both the greed of the bad rulers and the foresight of good ones caused the adoption of rational forestry methods.

The fact that in the United States the first impulse towards forestry reform has not come from the owners and exploiters, nor from economists or statesmen, but from people who had a scientific or

generally patriotic interest in the subject, has given the movement a very peculiar course. On the one hand, the circumstance was a fortunate one, for it enlisted in favor of reform a body of men of highly trained intelligence, who had no personal and pecuniary interests at stake and therefore could not fall under the suspicion of having private ends to serve whenever they urged upon the public the adoption of any particular policy. But there were serious drawbacks to this advantage. The public, who heard the subject discussed principally by botanists and writers on allied subjects, soon conceived the notion that forestry is primarily a question concerning scientists only, and not of general importance. This notion is not yet eradicated from the popular mind, any more than its sister error, that forestry is identical with tree planting, and that its practice is therefore promoted by getting people interested in setting out shade trees along roadsides or in the school grounds. Yet the botanists and horticulturists at least knew what they were about, so far as they went. True, they neglected almost entirely the business side of the problem, and devoted themselves exclusively to the question of preserving forests on account of the climatic and physiographical dangers accompanying their removal. But within this limited field they were serious and intelligent, and great praise is due to their efforts in promoting a more general understanding of these matters. Unfortunately, the same cannot be said of the horde of purveyors of light literature who

soon took up forestry as the latest fad. These people had no knowledge of their subject except what they might chance to remember from a superficial perusal of the writings of the botanists. But they presumed to speak in the name of forestry, and filled the newspapers and magazines with their productions, while a host of well-meaning preachers and popular lecturers seconded their efforts from the platform, with equal zeal and equal lack of information. The changes were rung *ad nauseam* on the fearful effects of forest destruction in the Mediterranean countries, while the lumberman was painted in the blackest colors as one who seeks a fiendish pleasure in destroying the primeval woods. The necessary consequence of this flood of misinformation was soon apparent. Forestry soon came to be looked upon as a fantastical idea of enthusiasts, a pretty subject to write verses about, a thing that had nothing to do with the practical, every-day affairs of life. Lumbermen and woodland owners, the very people who should have felt the greatest interest in the movement, because their pockets were most directly concerned, held aloof from it, and were kept from active opposition only by the contempt they felt for the whole agitation. This unfortunate result works its mischief to the present day, for even now there are large numbers of intelligent people who fail to understand the nature of forestry, even in the limited sense of the botanists, and certainly so in the true and comprehensive sense which for years a few energetic workers in

various parts of the country have tried to impress upon them.

When the work of the scientific men first began to bear fruit, it took the direction of simply setting aside tracts of forest land as reserves, with the idea of keeping them forever in a state of nature. The tracts selected for this purpose were chosen with a view to protect especially the headwaters of rivers, although other considerations also frequently influenced the choice. Both the federal and several state governments took steps in this direction. As to the federal government, the first reserves of this kind were the great national parks of the Yellowstone and the Yosemite. In these, the protection of the forests was but an incident to the object of making the many natural wonders and the beautiful scenery of these regions more accessible to the people, and keep them from being destroyed or at least monopolized by private greed. During the last few years, however, a large number of forest tracts in the Black Hills of Dakota, various parts of the Rocky Mountain system, and the ranges of the Pacific coast were similarly set aside, this time with the express double purpose of protecting the timber and the water supply needed for the irrigation works in the valleys and on the arid plains. A distinction must therefore be made between the national parks and the government forest reserves. Each class is governed by regulations differing in details according to the object in view and also according to differences in the local circumstances.

But both are alike in this, that at last effective steps are taken to guard against fires and timber thieves. The reservations set aside by various States likewise differ, inasmuch as their principal purpose is the preservation of forests or the reserving to the use of the people of districts conspicuous for their scenery or other natural beauties. For instance, the Adirondack forest reserve of the State of New York is a forest reserve proper, while the interstate reserve recently established by Minnesota and Wisconsin about the dells of the St. Croix River is analogous to the Yosemite Park.

The government forest reserves were established under the provisions of an act of Congress, approved on March 3, 1891, which authorizes the President to withdraw from entry and sale portions of the public domain which in his opinion are required for the protection of the waterflow and forest growth. Under this law over thirty such reservations have now been created, aggregating almost 50,000,000 acres, of which a portion, however, lies above the timber-line in the regions of eternal snow. It is likely that several more reservations will be established ere long. No appreciable opposition to this policy was at first encountered. But when by a proclamation of President Cleveland, dated February 22, 1897, the aggregate extent of the reservations theretofore created was increased very much by the addition of several more very large tracts, a determined opposition arose on the part of several interests which believed themselves

injured by the act of the government. Mine owners claimed that they were prevented by the order from developing valuable mineral lands; lumbermen grumbled that their timber supply was being cut short. It was stated that the tracts set aside included agricultural lands, and even village sites, and that numerous settlers were cut off from communication with the outside world. But the loudest clamor came from the sheepmen, who had been in the habit of driving their immense flocks over the public lands without let or hindrance, leaving destruction in their paths. The opposition succeeded in getting the Senate to insert in the Sundry Civil Bill, during the session of 1898, a clause suspending the operation of the orders indefinitely, and restoring the tracts covered by them to that part of the public domain open to private entry. Fortunately, this aroused the friends of the policy. It was shown that most of the arguments of the opposition were based on an intentional or unintentional misrepresentation of the facts. The House of Representatives refused to accept the amendment of the Senate, and in conference the latter receded from its position. Since that time, President McKinley has established several more forest reservations, mostly in compliance with requests from the people of the surrounding regions themselves. The opposition has almost entirely collapsed, and even some of the sheepmen have seen the error of their ways.

The government had laid itself open to attack from the business interests of the territory affected

by the orders, because the plan, as originally conceived, was based on the old idea that preserving a forest means refraining from utilizing it. No provision whatever was made in the original law for the proper management of the forests so reserved. In this the United States followed the policy adopted by the States that had theretofore set aside forest reserves. With no little show of reason it could be said that the withdrawal of these immense compact areas of land from settlement interfered with the development of the States and Territories in which they were situated. Large portions of these States were thereby doomed to remain in the condition of useless wilds. At first no provision was made even for a proper policing of the reservations against fire and thieves. But this defect was remedied in 1898 by the appropriation of a moderate sum for the organization of a police service. The land office, under the control of which these reservations are placed, at once established a service of fire rangers, and in the very first season it was reported that the number and destructiveness of fires in the reservations had been greatly diminished, although the organization was still admittedly imperfect.

By the rules promulgated for the government of the federal reservations all business interests established within their limits are duly protected. Settlers who had acquired possession of lands before the tract was withdrawn from entry are allowed to build roads and cut timber for domestic and farm

use. Mines may be worked and timber cut for their operation, under proper regulations. Even the sheep are admitted, to the northern reserves at least, where the humidity of the climate is greater and the danger of soil destruction by trampling less imminent. But the number of animals that may be pastured on a given area is limited, and the owners must take satisfactory precautions against fire, on pain of being excluded from the reservation. All these measures are desirable as far as they go. But the policy of our federal government with regard to its forests cannot be called a truly rational one until the beginning has been made to exploit them with due regard to reproduction and improvement of the stock. To introduce silvicultural forestry on such large areas must, of course, be the gradual progress of many years. But there is no reason why the first steps should not be taken at once. When such operations are fairly under way, the people of those western States will discover that far from being a drawback to the development of the country these mountain forests will be one of the greatest sources of wealth at their command.

Nowhere has the fact been more emphatically shown, that the great body of the public has not yet grasped the idea of combining forest utilization and preservation, than in the attitude of the State of New York. When in 1894 the constitutional convention met, a clamorous demand was made upon it to take steps for the protection of

forests. The demand came almost exclusively from persons who had no business interests connected with forest exploitation, and many of the most enthusiastic friends of the forests, in the newspapers and elsewhere, had but very slender information on the subject. All they knew was that forests were being destroyed, that such destruction was detrimental to the climate, waterflow, and fertility of the soil, and that the forests were the great recreation grounds of the people. They were determined that this destruction of forests must stop, and the convention did what the people demanded. A clause was inserted in the constitution prohibiting entirely the cutting of timber on public lands. Consequently, the magnificent state forests of New York, comprising over half a million of acres, are doomed to lie idle and useless until this well-meant but ill-advised provision has been repealed. The State of New York, however, has given other States a good example in not only appropriating large sums of money for the acquisition of additional forest lands, but also establishing a fairly efficient system of fire police. As a result of this, New York suffers less from forest fires at the present day than probably any other State of the Union.

It would swell this chapter to unreasonable length were we to insert an enumeration of all that has been done by the legislative and administrative action of the various state governments towards a solution of the forestry question. Some

of the States, notably, in addition to New York, Pennsylvania and Minnesota, are somewhat in advance of the rest, while others, whose forest interests are among the greatest, like Michigan and Wisconsin, lag far behind, and still others, like most of the southern States, have done nothing at all. A number of States have established forestry commissions, whose duties, however, are merely of an advisory nature, without administrative functions. Where forest reservations have been set apart, the idea of a mere park or unused wilderness is everywhere prevalent, and nowhere has silvicultural forestry been begun by public authority, except in connection with the new State College of Forestry at Cornell University. Of this we will have more to say anon. In several States, geological surveys and agricultural experiment stations have done valuable work in making inquiries into the forest conditions existing in their respective localities. This is especially true of North Carolina and Minnesota. In California, an experiment station has been established which has devoted itself with success to the acclimatization of trees from Australia and Asia.

More important than the forest inquiries conducted by the several States is the similar work carried on under the auspices of the federal government by the Forestry Division of the Agricultural Department. It dates back to the year 1878, but did not become of very much importance until about eight years later, when Dr. B. E. Fernow, a

forester who had received his training in the woods and schools of Germany, was placed at its head. He continued in this position until 1898, when he was called to the head of the Forestry College at Ithaca, N. Y. Under his management it became one of the special aims of the Division to gain the good will of the lumbermen and other forestal business interests by collecting information of immediate practical importance to them. In addition, the chief and his assistants sought by writing and lectures to spread among the people correct information on forestry subjects, and to their efforts it is due in no small degree that the attitude towards forestry both of the business interests and the public at large has begun to change very rapidly during the last few years. Dr. Fernow's successor in office is Mr. Gifford Pinchot, also a man of European training, as well as large practical experience in forestry matters in this country. Mr. Pinchot has added to the other work of the Division a system by which owners of woodlands may call upon the officials to advise them in the institution of plans for silvicultural treatment of their properties. The new departure has met with unexpected success and marks the first step towards general introduction of silvicultural forestry in this country.

It should not be supposed that no silviculture at all had been practised before this time in the United States. Aside from the planting of tree belts on the plains, which has repeatedly been referred to, and what tree planting approaching the

dimensions of forests may have been done in various public or private parks, numerous groves have been planted in various parts of the country with a direct view to their prospective money value, principally of black walnut and other high-priced hard woods. Again, where the owner of timber-lots of more or less extent happened to have some slight knowledge of its proper treatment, or had an opportunity to take the advice of some one who had such information, he has managed his little forest according to something like rational principles. Although wood-lots so treated are few and far between, as compared with the number of such holdings in the country, yet their aggregate acreage, if it could be ascertained, would show a respectable figure. In Southern California, considerable tracts have been planted with eucalyptus and other trees imported from Australia. Still, all these forestal operations were of small proportions. But silvicultural forestry on a large scale was successfully introduced, seven or eight years ago, on the famous Biltmore estate in North Carolina belonging to Mr. Geo. W. Vanderbilt. The work was begun under the direction of Mr. Gifford Pinchot, and since his retirement has been carried on by Dr. C. A. Schenck, another forester of German training. The operations in this forest were begun under rather unfavorable circumstances. Most of the valuable timber had been culled by lumbermen, and the farmers who had been the former owners had done untold mischief by fire, cattle, injudicious cut-

ting, and other bad practices. Under these circumstances, it will take a great many years, during which large expenses are necessary, to bring the forest gradually to something like what is called a normal condition. Notwithstanding these drawbacks, it is understood that the enterprise has so far been a financial success. Other estates of considerable size, which were managed according to true forestry principles before the above mentioned offer of the Forestry Division, are those at Ne-Ha-Sa-Ne Park, in the Adirondacks, belonging to Wm. C. Whitney and W. S. Webb. Since the government has begun to assist directly in this work, in the fall of 1898, the extent of woodland in behalf of which applications for working plans and supervision have been made is nearly two millions of acres in various parts of the country. The most cheering feature of the matter is that the majority of the applicants are no longer rich men whose motives, like Mr. Vanderbilt's, are as much to set a good example as to make money. Most of them look at the plan strictly from a business standpoint. Of the large concerns which have availed themselves of the offer, the most conspicuous one is the International Paper Company, commonly known as the paper trust, which is said to control more than a hundred million acres of woodlands, mostly covered with spruce.

While these forward steps mark the beginning of a new epoch in the history of American forestry, the time when agitation and the dissemination

of instruction was of the first necessity has not yet entirely passed by. Much still remains to be done, for while the light may be slowly breaking through the clouds, a large part of the nation still remains in ignorance of the true nature of forestry and the needs of the people in regard to it. Legislation of the kind indicated in previous chapters is still to be brought about in those States which have so far entirely neglected it, and existing laws must be improved and their scope extended. As yet, while public opinion has very generally become favorable to forestry reform instead of ridiculing it as formerly, this favorable attitude has not crystallized into anything more than a vague sentiment. In most States all practical efforts are left to a few individuals, on whom falls the duty of piloting proposed measures through the devious channels along which legislative bodies do their work. It is encouraging that in such attempts ordinarily little opposition based on arguments, however fallacious, in encountered. But everybody at all acquainted with the manner in which legislation is brought about, in Congress as well as in the State legislatures, knows that the mere absence of active opposition is not sufficient to insure the passage of a bill. It is necessary to arouse an active interest among the members, otherwise the mere deadweight of indifference is enough to keep it from becoming a law. Even where such active interest within the legislative bodies exists, the fate of forestry bills is apt to become entangled with that

of others in no wise germane to them, according to the exigencies of the interests and ambitions of members.

One of the most efficient agencies of agitation in behalf of forestry reform is the American Forestry Association, with its affiliated societies in several of the States. The American Forestry Association was founded in 1882. From small beginnings it has grown to be a very influential body, as is perhaps best shown by the abuse occasionally heaped upon it by western sheepmen and other parties, whose real or imagined interests conflict with its aims. It numbers among its members prominent men in all walks of life, including lumbermen, manufacturers, statesmen, and scientists. The association holds meetings, from time to time, in various parts of the country, at which papers are read, questions of general interest discussed, and other business transacted. The meeting of the association in any given community usually results in a great quickening of local interest in forestry matters, with consequent good results in practice and legislation. The association also publishes a monthly periodical, called *The Forester*, which is doing excellent service in spreading information, affording a medium of discussion and collecting news in forestry matters. This magazine was originally founded by Mr. John Gifford, of New Jersey, one of the pioneers in the forestry-reform movement. He transferred it to the association, to be its official organ. Another similar publication is *Forest*

Leaves, appearing under the auspices of the Pennsylvania Forestry Association. The excellent periodical called *Garden and Forest*, which had forestry for one of its fields of work, has unfortunately been obliged to suspend. In this connection it should be stated that the lumbering and other trade papers representing industries dependent on forests are now mostly among the stanchest supporters of improved methods. At first these people were very contemptuous of the entire movement. But gradually they discovered that forestry reform was not a fad of theorists, dreamers, and impracticables, but a very business-like proposition, of the utmost importance to their branches of trade, as well as to the whole nation.

The above partial enumeration of what is being done in the United States for the promotion of better treatment and utilization of our forest resources must suffice for the purposes of this little volume. We are nearing the end of our cursory survey of the vast subject. One thing remains to be discussed: The work of introducing into this country a better system of managing forests requires the best powers of a multitude of trained men. How can such men be found? How shall they be prepared for their work? What qualifications they should possess, and what are the rewards that may be held out to them?

CHAPTER XII

FORESTRY AS A PROFESSION

THE profession of forestry is distinguished for this, that it brings one into touch with more branches of knowledge and more fields of work than any other, excepting only the profession of law. When we speak of a professional forester we are apt to think mostly of the man who manages a given tract of woodland, superintends the proper silvicultural labors, and markets the products. Yet that is but a branch of forestry. He also is a forester who administers the various laws regulating the treatment of forest lands in the interest of the national life; and the name should not be withheld from men whose life-work consists of investigations into the physical and economic conditions on which the forestry of the nation is based.

On its silvicultural and technical side, forestry must be based on a sound comprehension of the physical and biological sciences. Geology, to understand the relations of soils and topographical conditions; botany, in all its branches, to comprehend the life of the material he has to deal with; zoölogy, to learn how the animal world affects his trees; meteorology, to get an insight into the

climatic requirements of his forest; all of these must be assiduously studied by the forester. Mathematics is evidently a fundamental part of his equipment, for without its aid an accurate mensuration of his property is impossible, and all calculations regarding its value would hang in the air. Moreover, a certain knowledge of mathematics is required for road building and similar operations, for which the aid of an engineer is not always available.

Leaving the technical branch of forestry, we find that on the economic side a comprehension of the laws which regulate the production, distribution, and consumption of wealth is needed, in order that the financial results of forestal operations may not be left to chance. The administrative side, at last, requires an understanding of the whole complex life of the nation and even of the whole human world, so that the work may be properly adapted to its place as but one wheel in the gigantic machinery of society. To this end the social and political relations of the nation,—history, law, and government—must not be unknown to the forester who wishes to be a master in his chosen field.

It stands to reason that no man can be equally proficient in all these branches of his art, even theoretically, not to speak of their practical application. But a knowledge of their fundamental principles is necessary to all members of the profession. After that has been acquired each man will become a specialist in some chosen field, according to his taste

or opportunities. It is sometimes stated as the ideal of a well-informed man,—to know something about everything and all about something. This is peculiarly applicable to the well-trained forester.

To some readers, men who pride themselves upon their practical sense, all this may seem somewhat extravagant. They may think that for each particular kind of work a far less comprehensive training is entirely sufficient. From one point of view they are right. To learn the silvicultural operations demanded in a given locality requires no university training. Any fairly intelligent woodsman would learn them in a short time, provided somebody taught him. But suppose that this woodsman were transferred to another district where forestal conditions were different. Would he be able to conduct the operations required under the altered circumstances without first being taught again? Clearly not. The difference is the same as that in a large factory or foundry, where an intelligent man with practical training at the workbench may make an excellent foreman; but the general superintendent of the works, the man who plans and devises, must be an instructed and trained engineer. It is the distinction between the artisan and the professional man.

Of course, it is emphatically true that mere scholastic training, however thorough and broad, does not make the forester, any more than it makes the lawyer or the physician. To native gifts and scholastic instruction must be added the training received

nowhere but in the actual life of the world, in the intercourse with men. The forester is not a man of science—not primarily a scholar. This should be urged continually in the United States, because the contrary view is still so prevalent and prevents a just appreciation of the forester's work. He is a man of business. More important than his knowledge of trees and lumber and lands, more important than his mathematical or economic lore, is his knowledge of men. With men he has to deal, whether he is in the woods superintending a gang of workmen, or going into the market to drive shrewd bargains and sell his wares; or whether he sits in an office at the state capital directing his subordinates and consulting with politicians.

This necessity of dealing with men is another reason why the forester should be a professional man rather than an artisan. The craft of the latter works upon dead matter; a profession influences living men. It is a reason, also, why the training of a forester at college should not be a narrowly technical one. For a broad, liberal culture is the best basis for a deep and comprehensive insight into the ways of men of all classes.

Having thus fixed the standard for a forester's training, let us see what means there are in the United States for obtaining it.

The methods of giving forestry instruction in Germany, the classical land both of universities and forestry, cannot be closely copied in the United States for many reasons. One of these is that the

only object of German instruction is to create a body of men capable of filling places in the elaborate forestry service of that country. Our aims must be different. Undoubtedly, as the introduction of silvicultural forestry progresses, an increasing demand for expert managers of woodlands will arise. These our colleges and universities ought to supply. But they ought to do more. For a long time to come there will be many men who, without being professional foresters, will find it desirable in their business of lumbering, or other industries, dependent on forest products, to have a comprehensive insight into forestry in all its branches. Moreover, it is certain that the question of proper treatment of our forest resources will soon play, for a time, a very important part in the public life of our nation. For this reason, many students in all departments will wish to have a proper understanding of the relations the forests and forest industries bear to the national life. To these non-professional students the purely technical branches, like silviculture and mensuration, will be of minor importance. But forestry, on its economic, administrative, and political side, will be very attractive.

The needs of both the professional and non-professional class of students have been admirably provided for in the New York State College of Forestry, which in the yea as opened as an integral part of Cornell ersity, at Ithaca. Far from considering his department a mere

training-school, where young men are given the rudiments of forestry in the shortest possible time, the dean of this institution, Dr. B. E. Fernow, believes that a forester should first of all be a man of liberal education. He therefore provides a curriculum, the first two years of which are spent in acquiring fundamental and general training and information. While the sciences, as is proper, take the first rank in the student's tasks, languages and literature are not neglected. Not until the third college year do technical forestry studies begin. In the fourth year, the future forester's work becomes intensely practical. The university possesses a large tract of forest land in the Adirondacks, the gift of the State. Here the senior students will learn, under the supervision of Professors Filibert Roth and John Gifford, the various technical operations required in forestry, from seeding and planting trees to sawing the logs into lumber. It is the intention of the university to make its forest a shining example of how a forest should be managed, and the aim will therefore be, not only to afford instruction to the students, but to make the management a financial success.

At Biltmore, the North Carolina forest estate which has frequently been mentioned, Doctor Schenck has opened a school where students of sufficient preliminary training may become professional foresters. The Forestry Division of the United States Agricultural Department also has a limited number of places for student-employees,

where young men of suitable preparation may get a professional training as assistants in actual forestry work, both in the field and in the office. For a good many years to come, every forester trained in America will find it quite an essential part of his education to spend some time in the forests of Central Europe; for in this country he may see beginnings of silvicultural operations, but not their later progress and final results. The various agricultural colleges, as well as some other similar institutions throughout the country, sometimes offer courses in forestry, and a few even have professors of that subject. These courses are not designed to train professional foresters, nor even to give that broad and comprehensive insight into forestry which is striven for at Cornell for non-professional students. They simply aim to teach the young farmers, dairymen, and followers of similar occupations who attend these schools, the elements of arboriculture, the relations of forests to climate and waterflow, and the importance of forests in the economy of the nation. Within these limits, courses of this kind do a great deal of good, both by teaching the students many things of advantage to them in their agricultural work, and by spreading among broad masses of the people juster notions about the value of our forest resources. Many of the teachers engaged in this work are men of considerable ability, and some are doing excellent service by original investigations and by their influence on public opinion. The main criticism to make is

that not rarely the designating as forestry what is really a branch of horticulture tends to perpetuate a confusion which has already done much mischief.

It is very probable that within a few years some of these colleges, and especially those connected with the greater universities, will extend their forestry courses and perhaps attempt to give instruction similar to that at Cornell. If that is done, and unless a separate College of Forestry is established, the instruction in this branch ought to be severed from the agricultural department. Forestry as a profession and the pursuit of agriculture have but little in common. Nor does forestry belong properly with the Department of Science. Its true relations are with economics or civics. To the professional student the correlation of forestry with other departments of the university will perhaps make little difference. But it will be of great importance in attracting to its comprehensive courses those students from whose number will come the future leaders in public affairs, and who are not ordinarily found in the scientific department. The scientific men, botanists and others, have heretofore taken so prominent a part in the American forestry movement that it may seem natural to some university men to make forestry instruction a branch of physical and biological science teaching. To me this would appear to be a mistake that might prove a serious hindrance in the work.

What opportunities to engage in their chosen

profession will there be for young men trained as is here indicated? A few years ago, the answer would have had to be: There are practically none in the United States. But circumstances are changing very rapidly indeed, and the demand for trained foresters will probably soon outrun the supply and continue to do so for some time. In the first place there will be opportunities for remunerative work in the service of both the United States and several of the States. More desirable, from a pecuniary standpoint, will probably be positions in the service of large corporations owning timber lands. There will also be a field for private practice as consulting foresters and appraisers, just as there are now consulting engineers and men who make a business of estimating the value of manufacturing plants. Then there will be opportunities afforded by the universities and experiment stations for men to devote themselves to original investigation and teaching of forestry. This profession, like all others worthy of the name, will never be a ready means for acquiring great wealth. That must be left to speculation and trade. But forestry will afford a respectable livelihood, and, for the rest, it carries with it certain intrinsic rewards which ought to make it attractive to a good many young men of ability. The many-sidedness of the work is one of these attractions. Forestry engages the whole man, not merely a particular side of his nature. The work in the field is often arduous in the extreme, and a rugged bodily constitution is

required of the forester; soon, indeed, the novice will discover the difference between camping in the woods for recreation and working in them. But then, the outdoor life and intimacy with nature, of which this work requires so much, will in itself be a pleasure to not a few. One chief advantage which the American forester will have for some time to come over the members of other professions, as well as his brethren in Europe, is that his is pioneer work. He is called upon to lay the foundations on which future generations will build. That is a fearful responsibility, for the way in which each forester of the next twenty-five years will do his duty is bound to be of immeasurable influence upon the future destiny of the American people. But it is also an opportunity such as does not often come to a body of workers. Grave responsibilities are of themselves powerful attractions to strong men.

Let us hope, in behalf of the welfare of our country and nation, that, as the initial decades of the new century shall make more and more apparent the crying need for improvement in the treatment of this great natural foundation of our life as a people, there will arise a class of men able to perform the tasks that will be thrust upon them. Those tasks will call for the services of the highest type of American manhood. We will need men capable of attending to the smallest detail as well as grasping the vast relations of their work with the highest interests of mankind. No pygmy men

are sufficient to cope with the subject, no pedants of the school or of the workshop, nor men with the day laborer's mind, counting their wages. Nor have we room to spare for the dealer in words,—the boaster, the flighty hero of the mass meeting or the political convention. Men are needed of quiet enthusiasm, courage, strength, and knowledge, men who have a sense of the dignity of their task, who deem their work far greater than themselves, who take rewards gladly when they come, but do not shape their course for them. Never yet has the American nation failed to find such men when they were needed. Here they are needed to do work that is not picturesque like that of the soldier or sailor, nor done in the sight of all like the orator's and statesman's, but work that is drudgery, —not a little of it—and will never earn the acclaims of the multitude. Shall America be deserted in this need of hers?

Our survey of American forests and forestry has come to its end. Imperfect though the work undoubtedly is, the author trusts that it may accomplish some of the purposes for which it was written. It is not intended to serve as a manual of forestry or any branch of it. But it has been our aim to give a comprehensive insight into one of the most important of the phases of our national life to the large number of Americans who feel that they must understand these phases in order to become true citizens.

It is not necessary to impress upon Americans

the truth that the higher life of a nation,—its moral development, the life of the spirit, intellectual and æsthetic aspirations,—must rest upon a solid foundation of material achievement. We are but too prone to consider that foundation of more importance than the superstructure. Attending to the material needs with all too exclusive absorption, many of us lose touch with immaterial things, and the mind becomes degraded to what it works in, as the dyer's hand assumes the color of his cauldron. The forester's work is primarily concerned with material things. He is exploiting the gifts of nature to supply the material wants and luxuries of man, and in doing so aims to get his portion of personal benefit. But if he has truly grasped the significance of his profession, he realizes that his work is not done for himself alone, nor merely in order that the lower desires of others may be gratified. He knows that he is an integral, necessary part of the grand organism of the American nation, taking his appointed place to do his appointed work. Compared to the life of that sublime organism, the life of the individual, his personal successes, his sufferings and joys, are nothing. His work is everything. Let him be steadfast and do it.

And because the work of forestry is but a part of a grander and more important whole, a part that cannot be dispensed with any more than the ploughing and reaping of the farmer, the hammering and riveting of the mechanic, as well as the labors of those who are leaders of men in all divisions of life;

because forestry is one of the great foundation-stones of the nation, it behooves every American to have a just conception of its meaning. Such a conception the author has tried to give. It is not necessary, for this purpose, to know much about the technical details of the forester's labors. The mysteries of silviculture and mensuration, let them remain mysteries to all but those whose business it is to apply these arts. The complicated lore of the lumber camp and the sawmill, the jargon of the market, would be a useless burden to the memories of all but those whose business requires such knowledge. But how can one intelligently participate in the great social and political life of our people; how especially dare one aspire to take a leader's part on any of the multifarious roads along which travels the nation's progress, unless he sees the relation which this vast subject of forestry bears to the other great interests of our people? Therefore this book hopes to impart to some educated and intelligent Americans a kind of knowledge on this subject, which as yet many of them utterly lack. Therefore we have tried to unroll a picture, inadequate though it must naturally be, of the American forests as they grew and flourished under the guidance of nature alone. We endeavored to show how the primeval woods were not the product of accident, a vast assemblage of trees growing where they did without order and reason, and having no relation or interdependence with each other and the rest of the natural life of the world. On the contrary, we

attempted to make clear that the forest was a complicated organism in which every part sustained definite relations to every other part, a natural community, which had its history, its internal struggles and outward battles, like the communities of men. To trace the processes of this organic life, to learn its determining factors, and discover the causal connections of the multitude of phenomena, is the first duty and one of the most important of the forester. It is a task full of difficulty but also of charm, a task to which only the deep and wide knowledge, the quick observation, the patient care of the trained intellect is equal, but which bears in itself its greatest reward.

Next we proceeded to show how the life of the white man on American soil was from the first determined in no small degree by the existence of the forest. To that ever-present fact the whole life of the nascent American people had to accommodate itself. We had to resist the temptation to dwell too long on the heroic age of American history, which in the dark shades of the eastern forest unrolled the spectacle of civilized man being thrown back on primeval conditions, having to fight for his life with the uncontrolled forces of nature, while struggling for mastery against the red Indian, the Frenchman, and the Spaniard. Upon the age of the backwoodsman and the fur-trader followed the age of the lumberman. While in the preceding period the small host of white invaders came under the influence of the forest in which they dwelt so

completely that an entirely new type of man was created thereby, things were reversed in the new days. Re-enforced by the railroad and the manifold machinery of an industrial civilization, man now conquered the forest. He made it subject to himself and took of its treasures what pleased him. But in the zeal and haste of the victory the American people were in danger of destroying that which, lovingly and understandingly cared for, would become their best friend. So we approached the second part of our subject, and began to consider how the interests of the nation could best be served with regard to treating this immense natural source of wealth which had become ours. First we found in our path all manner of misconceptions and erroneous impressions regarding forestry. Having cleared these out of our way, we came to the conclusion that forests are indeed necessary to our country, as great regulators of meteorological processes mitigating the evil effects of storm and flood, keeping erosion down to a moderate degree, and influencing climatic conditions. For these reasons alone we found that it would be wise to save the remnants of the natural forest from destruction. But we were able to go a step farther and say that it is not necessary, in order to so preserve them, to refrain from utilizing the products of the forest for the hundreds of uses to which man's ingenuity has put them. On the contrary, we found that a wise treatment would enable us to gain even more of these products than the natural forest would furnish, and yet not only

leave its permanency assured, but even increase its vigor and value.

Thus we were led to consider the reasons why the methods of silvicultural forestry had not yet been more widely adopted in this country. There we concluded that conditions dependent on the action of legislation and government arose as obstacles in the way of private enterprise in this direction. Here we arrived at one of the most obvious reasons why such a book as this has a right to exist and a work to perform: Legislation depends upon public opinion, and public opinion must be created and instructed by just such means as this.

May this little book do its share in creating this necessary instrument for the solution of the forestry problem. Democracy, which was born in America and was the first great contribution of the western hemisphere to civilization, is entering upon a new epoch, in which it will be subjected to new and tremendous tests before it can be definitely upheld as a practicable scheme for the organization of a great nation. Until now the test has not been a fair one, for the environment of the American people offered too many adventitious advantages. We were a people comparatively homogeneous, without deep and wide divisions based upon racial, religious, economic, or social distinctions. With the one exception of the conflict about slavery, all our political and social contentions touched little more than the surface of our body politic. That one struggle, to be sure, came but too near to prove Democracy a

failure. But far severer tests may be in store for us. Within a short time our social organization has become infinitely more complex than formerly, and the dividing lines between the different classes have become more difficult to cross. It is growing harder and harder for the eastern man to understand the mental and moral attitude of his western compatriot, and for both to understand the Californian. The multitudes of our citizens whose ancestry is other than British do not think and feel in every way as the British descendant does, and in the sections where they predominate a new type of American is gradually evolving, different in many ways from the type the world used to know. We are no longer a Protestant people; and who will say that we always comprehend how our Catholic fellow-citizen looks at things. Worse than all, we now have what we used to boast of not having: a proletariat, a class of men sunk into a kind of poverty that is not merely a temporary condition from which ability and self-control can raise the poor man or his children, but a poverty which constitutes a hopeless, helpless limbo, a social cesspool of ignorance, vice, and degeneracy. Surely, here are many causes for social and political struggles that may in the future shake nation and society to their deepest foundations.

To those who see the hope of mankind in a perfected and purified Democracy, the right solution, by our democratic society, of such a problem as that of forestry reform would be of particularly

cheerful omen. That Democracy can repulse foreign aggression and even aggressively exert its masterfulness, we know. That it is able to cope with problems which arouse the depths of all men's emotions and bring to white heat the fire of patriotic and moral fervor, the solving of the slavery question has taught us. But this question of forestry cannot be solved by sudden bursts of enthusiasm, and does not appeal to man's emotional nature. It must be solved by seventy millions of men and women, each of whom has his own particular interests to make him indifferent to what concerns him little individually. This must be done by simple, cold-blooded, calculating reason, in the face of all the opposition which can be generated by habits contracted during seven generations, conflicting interests of private parties, and the dead-weight of unreasoning conservatism. If Democracy is able to perform such a feat as this, it need not shrink from the more exciting tasks which the future may have in store for it.

It looks as if American Democracy were going to perform the feat. Let every lover of his country do his part in the work.

INDEX

The Science Series

Edited by Professor J. McKeen Cattell, Columbia University, with the coöperation of Frank Evers Beddard, F.R.S., in Great Britain.

Each volume of the series will treat some department of science with reference to the most recent advances, and will be contributed by an author of acknowledged authority. Every effort will be made to maintain the standard set by the first volumes, until the series shall represent the more important aspects of contemporary science. The advance of science has been so rapid, and its place in modern life has become so dominant, that it is needful to revise continually the statement of its results, and to put these in a form that is intelligible and attractive. The man of science can himself be a specialist in one department only, yet it is necessary for him to keep abreast of scientific progress in many directions. The results of modern science are of use in nearly every profession and calling, and are an essential part of modern education and culture. A series of scientific books, such as has been planned, should be assured of a wide circulation, and should contribute greatly to the advance and diffusion of scientific knowledge.

The volumes will be in octavo form, and will be fully illustrated in so far as the subject-matter calls for illustrations.

G. P. PUTNAM'S SONS, New York & London

THE SCIENCE SERIES

(Volumes ready, in press, and in preparation.)

The Study of Man. By Professor A. C. HADDON, M.A., D.Sc., Royal College of Science, Dublin. Illustrated. 8°, $2.00

The Groundwork of Science. A Study of Epistemology. By ST. GEORGE MIVART, F.R.S. 8°, $1.75

Rivers of North America. A Reading Lesson for Students of Geography and Geology. By ISRAEL C. RUSSELL, LL.D., Professor of Geology in the University of Michigan. Illustrated. 8°, $2.00

Earth Sculpture. By Professor JAMES GEIKIE, F.R.S., University of Edinburgh. Illustrated. 8°, $2.00

Volcanoes. By T. G. BONNEY, F.R.S., University College, London. Illustrated. 8°, $2.00

Bacteria. By G. NEWMAN, M.D., F.R.S., Demonstrator of Bacteriology in King's College, London. Illustrated. 8°, $2.00.

Whales. By F. E. BEDDARD, F.R.S., Zoölogical Society, London. Illustrated. 8°.

The Stars. By Professor SIMON NEWCOMB, U.S.N., Nautical Almanac Office, and Johns Hopkins University.

Meteors and Comets. By Professor C. A. YOUNG, Princeton University.

The Measurement of the Earth. By Professor T. C. MENDENHALL Worcester Polytechnic Institute, formerly Superintendent of the U. S. Coast and Geodetic Survey.

Earthquakes. By Major C. E. DUTTON, U.S.A.

The History of Science. By C. S. PEIRCE.

Recent Theories of Evolution. By J. MARK BALDWIN, Princeton University.

The Reproduction of Living Beings. By Professor MARCUS HARTOG, Queen's College, Cork.

Man and the Higher Apes. By Dr. A. KEITH, F.R.C.S.

Heredity. By J. ARTHUR THOMPSON, School of Medicine, Edinburgh.

Life Areas of North America: A Study in the Distribution of Animals and Plants. By Dr. C. HART MERRIAM, Chief of the Biological Survey, U. S. Department of Agriculture.

Age, Growth, Sex, and Death. By Professor CHARLES S. MINOT, Harvard Medical School.

History of Botany. Professor A. H. GREEN.

Planetary Motion. G. W. HILL.

Infection and Immunity. GEO. M. STERNBERG, Surgeon-General U.S.A.

Books for the Country

NATURE STUDIES IN BERKSHIRE. By JOHN COLEMAN ADAMS. With 16 illustrations in photogravure from original photographs by ARTHUR SCOTT. 8°, gilt top, $4.50.

A collection of prose pictures of skies and woods and fields, intermingled with the reflections of a writer who is at once a philosopher and a poet, one who enjoys profoundly the beauties of the Berkshire Hills, and who possesses the art of enabling his reader to share in his enjoyment.

LANDSCAPE GARDENING. Notes and Suggestions on Lawns and Lawn-Planting, Laying out and Arrangement of Country Places, Large and Small Parks, etc. By SAMUEL PARSONS, Jr., Ex-Superintendent of Parks, New York City. With nearly 200 illustrations. Large 8°, $3.50.

"Mr. Parsons proves himself a master of his art as a landscape gardener, and this superb book should be studied by all who are concerned in the making of parks in other cities."—*Philadelphia Bulletin.*

LAWNS AND GARDENS. How to Beautify the Home Lot, the Pleasure Ground, and Garden. By N. JÖNSSON-ROSE, of the Department of Public Parks, New York City. With 172 plans and illustrations. Large 8°, gilt top, $3.50.

"Mr. Jönsson-Rose has prepared a treatise which will prove of genuine value to the large and increasing number of those who take a personal interest in their home grounds. It does not aim above the intelligence or æsthetic sense of the ordinary American citizen who has never given any thought to planting and to whom some of the profounder principles of garden-art make no convincing appeal."—*Garden and Forest.*

ORNAMENTAL SHRUBS. For Garden, Lawn, and Park Planting. By LUCIUS D. DAVIS. With over 100 illustrations. 8°, $3.50.

This volume is addressed to both scientific men, and that large class of persons who, though interested in plants, have no knowledge of Botany, and neither time nor inclination to acquire it. The phraseology is plain and the descriptions are easily comprehensible; yet the book contains material never before presented, relating to varieties of plants developed under cultivation.

THE LEAF COLLECTOR'S HANDBOOK AND HERBARIUM. An aid in the preservation and in the classification of specimen leaves of the trees of Northeastern America. By CHARLES S. NEWHALL. Illustrated. 8°, $2.00.

"The idea of the book is so good and so simple as to recommend itself at a glance to everybody who cares to know our trees or to make for any purpose a collection of their leaves."—*N. Y. Critic.*

THE WONDERS OF PLANT LIFE. By Mrs. S. B. HERRICK. Fully illustrated. 16°, $1.50.

"A dainty volume . . . opens up a whole world of fascination . . . full of information."—*Boston Advertiser.*

G. P. PUTNAM'S SONS, 27 & 29 West 23d St., New York

Books for the Country

OUR INSECT FRIENDS AND FOES. How to Collect, Preserve and Study Them. By BELLE S. CRAGIN. With over 250 illustrations. 8°, $1.75

Miss Cragin sets forth the pleasure to be derived from a systematic study of the habits of insects, and gives many points which will be of practical value to the beginner. She gives comprehensive descriptions of all the more important species to be found in the United States, together with illustrations of the same.

AMONG THE MOTHS AND BUTTERFLIES. By JULIA P. BALLARD. Illustrated. 8°, $1.50.

"The book, which is handsomely illustrated, is designed for young readers, relating some of the most curious facts of natural history in a singularly pleasant and instructive manner."—*N. Y. Tribune*

BIRD STUDIES. An account of the Land Birds of Eastern North America. By WILLIAM E. D. SCOTT. With 166 illustrations from original photographs. Quarto, leather back, gilt top, in a box, *net*, $5.00.

"A book of first class importance. . . . Mr. Scott has been a field naturalist for upwards of thirty years, and few persons have a more intimate acquaintance than he with bird life. His work will take high rank for scientific accuracy and we trust it may prove successful."—*London Speaker.*

WILD FLOWERS OF THE NORTHEASTERN STATES. Drawn and carefully described from life, without undue use of scientific nomenclature, by ELLEN MILLER and MARGARET C. WHITING. With 308 illustrations the size of life. 8°, *net*, $3.00.

"Anybody who can read English can use the work and make his identifications, and, in the case of some of the flowers, the drawings alone furnish all that is necessary. . . . The descriptions are as good of their kind as the drawings are of theirs."—*N. Y. Times.*

THE SHRUBS OF NORTHEASTERN AMERICA. By CHARLES S. NEWHALL. Fully illustrated. 8°, $1.75.

"This volume is beautifully printed on beautiful paper, and has a list of 116 illustrations calculated to explain the text. It has a mine of precious information, such as is seldom gathered within the covers of such a volume."—*Baltimore Farmer.*

THE VINES OF NORTHEASTERN AMERICA. By CHARLES S. NEWHALL. Fully illustrated. 8°, $1.75.

"The work is that of the true scientist, artistically presented in a popular form to an appreciative class of readers."—*The Churchman.*

THE TREES OF NORTHEASTERN AMERICA. By CHARLES S. NEWHALL. With illustrations made from tracings of the leaves of the various trees. 8°, $1.75.

"We believe this is the most complete and handsome volume of its kind, and on account of its completeness and the readiness with which it imparts information that everybody needs and few possess, it is invaluable."—*Binghamton Republican.*

G. P. PUTNAM'S SONS, 27 & 29 West 23d St., New York